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ABSTRACT

This report describes the results of a national survey of computer experiences in the public school districts that comprise the Appalachian Region. Data from this survey were used to examine the cumulative total of a variety of administrative computer policies that encouraging more widespread participation by teachers in learning computing and use of microcomputers as a tool for instruction in public school classes. Such policies include hardware support, computer and instructional for teachers, and the involvement of teaching staff in decisions about the implementation of microcomputer-based instruction. The report presents the conceptual framework for the study, outlines the literature on improving participation in computer training and encouraging educational innovations, describes the survey and presents the survey results, and discusses the implications of the findings for educational research and policy. Statistical data are presented in 12 tables, the survey instrument is appended, and references are provided. (AB)

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Administrative Policies for Increasing the Use of Microcomputers in Instruction

John D. Winkler, Cathleen Stasz
Richard Shavelson

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July 1986

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PREFACE

This report describes the policy mechanisms available to district and school administrators to encourage more widespread use of microcomputers as an instructional tool in subject matter courses. It analyzes the value of offering incentives to teachers, providing various forms of technical support, and involving the teaching staff in decisions about staff development and computer use. The report describes the consequences of such policies for increasing teacher participation in inservice computer training and for broadening the use of microcomputers for instruction in mathematics, science, social studies, and language arts in the elementary and secondary grades.

The results of this study should be useful to school administrators and teachers who seek to encourage greater use of microcomputers for subject matter instruction. The research should also interest education researchers concerned with staff development and the successful implementation of educational innovations. The study was supported by a grant from the National Institute of Education and by The Rand Corporation, using its own research funds.

SUMMARY

Many educators feel that the microcomputer has unique capabilities for improving the quality of instruction, and public schools and school districts are acquiring microcomputers at an increasing rate. However, microcomputers are now used primarily for enhancing computer literacy or as an object of instruction, not as a tool for teaching such subjects as mathematics, science, or language arts. Although many teachers are interested in using the new information technology, most of them lack the training to do so. They are apprehensive about the effort required to use computers and the incentives that are available for making that effort.

To facilitate training and to encourage more widespread use of computers for subject matter instruction, district and school administrators must provide greater encouragement. The best ways to motivate teachers to improve their skills and use microcomputers for instruction are not well known, however. This research examines this issue systematically by addressing two related questions:

- How can district and school administrators encourage teachers to gain proficiency and use microcomputers as a tool for instruction in subject matter classes?
- How effective are the various administrative policies that support microcomputers in the instructional program?

RESEARCH FRAMEWORK

We assume that administrative policies that promote or discourage the use of microcomputers contain incentives and disincentives for teacher training and instructional microcomputer use. The *incentive value* of a particular policy will determine the effort that teachers put into training and how widely microcomputers are used. Previous research shows that microcomputer-based instruction differs according to local context, and our framework further assumes that the impact of administrative computer policies is moderated by student composition, particularly by the percentage of minority students served.

This study attempts to identify the incentive value and relative effectiveness of specific policy mechanisms available to districts and schools. The literature in education suggests that, in general, policy mechanisms that demonstrate administrative commitment and support, involve teachers in decisions, and provide incentives and rewards

encourage teachers to participate in inservice training and to adopt innovations such as microcomputers. Examples of such policies include:

- Demonstrating commitment to microcomputer use by providing technical support in the form of hardware, educational software, inservice training, and readily available assistance.
- Actively involving teachers in decisions about the content and organization of inservice training and about the ways microcomputers will be used for instruction.
- Offering teachers "extrinsic" incentives such as salary credit or special recognition, as well as "intrinsic" incentives such as release time or opportunities to experiment with the technology.

Because some form of inservice training is usually provided in districts where computers are used, we examined the effectiveness of alternative administrative policies in encouraging teachers to participate in this training. We also examined the incentive value of organizational features of staff development and the effectiveness of alternative administrative policies in encouraging more widespread instructional use of microcomputers in more subjects and grades. Clearly, the first step to improving the use of microcomputers as an instructional tool is to increase such use. Only with experience can the pedagogical uses of this new technology be optimized.

NATIONAL SURVEY OF COMPUTER-USING DISTRICTS

To develop a database for this study, we undertook a telephone survey of individuals designated as computer supervisors in 155 public school districts that presently have microcomputers. Respondents were chosen at random from a comprehensive national listing of designees. We achieved a response rate of 91 percent of our starting sample. Some of the respondents were active computer-using teachers in the district; more of them were former computer-using teachers who had assumed administrative responsibility for providing assistance and inservice training to other teachers. Respondents were asked about the availability of microcomputers and courseware, details of any inservice training programs, and whether various incentives and forms of technical support were available to teachers who participate in training or use microcomputers for instruction in their districts. Respondents also provided estimates of the level of teacher participation in inservice training, as well as general descriptions of microcomputer use in their districts.

Participation in Staff Development

We examined teachers' participation in inservice training, the representation of teachers of different grades and subjects in such training, and organizational features of staff development. We found that increased technical support—in particular, increasing the number of microcomputers per teacher—is the most significant factor influencing teachers' inservice participation. Other important factors are the availability of resource persons in the schools; teacher participation in the planning of staff development; release time for workshops; and guaranteed access to microcomputers or software upon completion of training. The one organizational feature of inservice training found to have incentive value for increasing participation was the availability of inservice training at teachers' own schools. Our results also suggest that teachers of certain grades and subjects may be more responsive than others to some administrative policies and organizational features of staff development. For example, inservice attendance of elementary teachers improves when the training provides more "hands-on" computer time, offers promotions as an incentive for participation, and is mandatory rather than voluntary.

Breadth of Microcomputer Use

We examined the extent to which microcomputers are used as a tool for instruction in mathematics, science, social science, and English in elementary (K–6) and secondary (7–12) classes. Our results show that increased numbers of microcomputers per teacher, the availability of computer inservice training in the district, and the availability of routine curricular assistance in integrating microcomputers into ongoing instruction are critical to more widespread use of microcomputers for subject matter instruction. Technical assistance in integrating microcomputers—selecting optimal ways to deliver computer-based instruction to students, linking computer activities with ongoing instruction, and coordinating computer activities with other classroom activities—is especially significant, yet it is the least common form of technical assistance available in the districts we studied.

Another important incentive for increasing computer use is extra pay for teachers who use microcomputers. Extra pay outperforms all other traditional incentives, including special recognition and release time. Although it is rare in the districts we surveyed, extra pay could stimulate computer use where none has previously existed, or it might deter computer-using teachers from leaving the teaching profession.

These incentives appear to be the most effective mechanisms for increasing microcomputer use, but nearly all other forms of technical support are helpful in some degree.

Minority Composition

Our findings are qualified in important ways when we examine how minority student composition contributes to relationships between policies and outcomes in these districts. Some forms of technical support, such as assistance in integrating microcomputers into teachers' practices, are especially important for enhancing microcomputer use in schools that have a high proportion of black students. Offering inservice training is also more important for broadening the use of microcomputers in schools when there are more blacks among the student population. At the same time, acquiring courseware and increasing the availability of microcomputers encourages more widespread use, regardless of student minority composition.

CONCLUSIONS AND POLICY IMPLICATIONS

Our findings suggest that *districts and schools should continue to acquire microcomputers and educational courseware.* As the number of microcomputers per teacher rises, teacher training increases and instructional microcomputer use becomes more widespread. The districts surveyed in this study average less than one microcomputer for every two teachers and every 33 students. Today, only one-quarter of all U.S. schools have enough computers to serve more than one-half of a full classroom of students at a time. But acquiring more hardware and courseware will require sizable investments, and although many districts and schools have found imaginative ways to obtain computers, the need for ongoing capital investments and funding for training will require the continued commitment of government agencies at all levels. Districts and schools may also need more information about available aid.

This research also suggests that computer-using teachers should be provided with *centralized, routine assistance in integrating computers into instruction.* Curricular assistance is needed to help teachers match computer-based instruction to their instructional objectives. Teachers should be provided with computer curriculum advisers to assist them in optimizing their own computer use. These advisers should also assist teachers with choosing and making optimal use of hardware and software.

District inservice training is also necessary to broaden computer use. Our findings suggest that the use of computers in instruction will increase as inservice training is made more accessible to teachers. Further research is clearly needed on ways to enhance training effectiveness.

Finally, administrators should seek ways to *compensate computer-using teachers*. A few districts are implementing mechanisms such as computer master teacher programs, salary credits for computer use, and summer stipends for curriculum development. There is no doubt that the resources for such programs are scarce and that offering differential pay through such programs is controversial. But there is also no doubt about the exodus of trained teachers from the teaching profession and the high value of computer skills in today's labor market.

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1. INTRODUCTION

Microcomputers have been heralded as a great new vehicle for improving the quality of instruction. Many educators and technologists believe that microcomputers have unique instructional capabilities and benefits (e.g., Shavelson and Salomon, 1985), and these beliefs are not without basis. The weight of evidence, based on a large number of studies comparing computer-based and traditional instruction, suggests that computer-based instruction can improve students' performance and increase their rate of learning (Kulik, Bangert, and Williams, 1983; Bangert-Drowns, Kulik, and Kulik, 1985).[1]

While some educators still debate whether or how to apply microcomputer technology to improve instruction, it is clear that public schools and school districts are acquiring microcomputers at an increasing rate. The number of computers accessible to students has grown dramatically. According to the National Center for Education Statistics (NCES), the number of computers in public schools grew from 52,000 to 132,459 between fall 1980 and spring 1982. These figures include computer installations of all types; the growth is even more impressive among microcomputer installations, which more than tripled to over 100,000 units during this time. Since 1982, even more explosive growth has occurred, but accurate data are hard to come by. The number of microcomputers in schools in late 1984 was estimated at from 325,000 to over 1,000,000 (Grayson, 1984), and the number is said to be doubling every year (Bork, 1984).

The microcomputer explosion is occurring across the educational spectrum. According to the NCES, more than 31,000 schools—nearly 40 percent of U.S. public schools—had at least one computer installation in 1982; and about 29,000 had microcomputers. By January 1983, the proportion had already increased to 53 percent (Becker, 1983). Computer-owning schools had between four and five computers on average (Becker, 1983). In January 1983, 85 percent of all high schools, 68 percent of all junior high schools, and 42 percent of all elementary schools in the United States owned microcomputers.

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[1]Evidence to the contrary, however, is presented in Clark (in press).

PROSPECTS AND PROBLEMS FOR COMPUTER-BASED EDUCATION

These developments are remarkable, but they have not necessarily improved educational practice. Microcomputers may be more available, but are they being used widely or well? At present, microcomputers are seldom used for improving subject matter instruction (Becker, 1983), primarily because most teachers lack the training, knowledge, and time to use the new information technology (Isaacson, 1982; OTA, 1982; Stasz and Shavelson, 1985).

Present Instructional Uses of Microcomputers

Although computers are used by the vast majority of schools, their instructional use is limited primarily to computer science instruction and to enhancing computer literacy (Becker, 1983; NCES, 1982). Microcomputers are not commonly used as an instructional tool in subject matter courses, such as mathematics or science; nor are they widely used for testing or record-keeping (Becker, 1983). A 1982 NCES survey found that literacy and programming applications of computers are emphasized far more than remediation, basic skill enhancement, or learning enrichment. At present, the computer is advancing rapidly as a subject of instruction, but not as a tool for improving instruction in subject matter courses.

Even when microcomputers are used as an instructional tool, their pedagogical applications are often restricted. Potential uses of microcomputers include drill-and-practice for attaining skill mastery, tutorials for presenting material and subsequent testing of students' competency, and simulations for demonstrating the behavior of systems of variables (Rogers, 1984). Other possible applications include the use of word processing for teaching reading and writing and the use of databases to teach research and statistical skills. Of these possible computer-based learning methods, however, little more than small amounts of drill-and-practice can be found (Becker, 1983, 1986; Chambers and Bork, 1981). Drill-and-practice is used in elementary schools for enhancing or remediating basic reading and arithmetic skills (Becker, 1983), but tutorials and simulation programs, with their greater interactive and diagnostic potential, are still rare.

There is some concern that current trends in computer-based instruction may foster educational inequity (Lipkin, 1983). The special strength of computer use in instruction is that it can provide individualized instruction for students of all ability levels. Unfortunately, specialized instructional use of computers is often set up to segregate

students by subject matter (e.g., using microcomputers exclusively for math) or ability (e.g., simulation for gifted children or drill-and-practice for poor achievers) (Shavelson et al., 1984a). Some educators and analysts contend that a better arrangement from the standpoint of equity and pedagogy would be to incorporate computer-based learning activities into ongoing instruction across more subject areas and grade levels (Meister, 1984; Shavelson et al., 1984a; Winkler et al., 1985). This might promote the use of more sophisticated and advanced applications, and it would at least broaden students' exposure to the microcomputer and its capabilities.

Teacher Training for Microcomputer Use

The shortage of teachers qualified to use computers for instruction remains a significant barrier to increasing the breadth and quality of microcomputer use in instruction (U.S. Department of Education Task Force, 1981). Shortfalls in training occur for a number of reasons, including the lack of computer-related courses offered in teacher training institutions, the inability of economically pressed school districts to hire new teachers who have computer training, and the lack of knowledge about or agreement on the topics and organization of staff development programs (Shavelson et al., 1984a).

Even though some teachers have had previous exposure to computers, most of them do not know how to use microcomputers effectively (Isaacson, 1982; OTA, 1982). Even computer literacy, the most widespread application, is hampered by this shortage. In 1982, the NCES found that only one or two teachers per school were judged by their administrators to be "moderately" or "highly" qualified to teach computer literacy. The problem is especially acute regarding *instructional* use of computers. According to a 1982 National Education Association (NEA) survey, only 11 percent of the teachers in a national sample used a computer for instructional purposes, and only 6 percent were "frequent" current users (Becker, 1983).

Although relatively few teachers regularly use computers for instruction, many teachers express very positive attitudes toward classroom computer use, and many would like further training and experience (CPB, 1985; *Instructor*, 1982; NEA, 1982). At the same time, however, there is some apprehension about the imbalance between the effort required to acquire facility with computers and the incentives for doing so (Howe, 1982). How, then, can this interest be nurtured and more widespread use of the new technology be promoted? Computer use, like other educational innovations, requires changes of existing habits (Lipson, 1981). Many teachers will need direct encouragement from

their district or school administration to upgrade their skills and learn how to integrate microcomputer-based instruction into their teaching (Shavelson et al., 1984a; U.S. Department of Education Task Force, 1981).

Unfortunately, there is no direct evidence about the kinds of administrative support that are most effective in motivating teachers to improve their skills and use microcomputers for instruction (Moursund, 1979). The amount and type of incentives offered have not been systematically studied, nor have the determinants of teacher participation in inservice training or the use of microcomputers as an instructional tool been evaluated. The questions, moreover, do not have simple or straightforward answers. A study by Sheingold (1981), for example, found that many teachers who received salary credits for staff development had already reached maximum salary levels. In effect, such "incentives" were meaningless for these teachers.

PURPOSES AND ORGANIZATION OF THIS REPORT

This study attempts to determine the best ways to provide administrative support for microcomputer use as *an instructional tool in subject matter courses* such as mathematics or language arts. While we recognize that computer literacy and programming are important uses of computers in schools, we believe that if their full potential as an instructional tool is to be realized, microcomputers must be used in more grades to teach a wider spectrum of subjects. We therefore examine which administrative policies and combinations of actions provide the greatest incentive for increasing microcomputer-based, subject matter instruction. We address two related questions:

- How can district and school administrators encourage teachers to gain proficiency in microcomputer-based instruction, and to use microcomputers in their teaching?
- How effective are various administrative actions for encouraging teachers to participate in inservice training and to use microcomputers in their teaching?

This report describes the results of a national survey of computer supervisors in 155 public school districts that currently own microcomputers. Data from this survey are then used to examine the incentive value of a variety of administrative computer policies for encouraging more *widespread* inservice training and use of microcomputers in instruction—administrative policies pertaining to technical support, rewards and incentives for teachers, and involvement of teaching staff

in decisions about the implementation of microcomputer-based instruction.

Section II of the report presents the conceptual framework that guided this research and reviews suggestions made in the research literature for improving participation in inservice training and encouraging educational innovations. Section III describes the national survey of district computer supervisors and presents the results of this survey. Finally, Section IV discusses the implications of our findings for educational research and policy.

II. CONCEPTUAL FRAMEWORK

The conceptual framework that guided our inquiry identifies four areas of theoretical concern in encouraging teachers to participate in staff development and to use microcomputers as a tool for subject matter instruction (Fig. 1):

- Policy mechanisms available to districts and schools.
- Staff development in microcomputer teaching skills.
- Teachers' instructional use of microcomputers.
- Characteristics of the local context that may affect relationships among policies, training, and microcomputer use.

Our framework assumes that administrative computer policies contain incentives and disincentives that may encourage teachers or discourage them from upgrading their skills and using microcomputers for instruction. We seek to identify the *incentive value* of such policies, while accounting for differences in local contexts. There is little guidance or empirical evidence in the literature on administrative encouragement of training or instructional *microcomputer* use. Therefore, we have made two assumptions: (1) that microcomputers become assimilated into districts and schools in ways analogous to the adoption of other educational innovations (Lipson, 1981), and (2) that we can

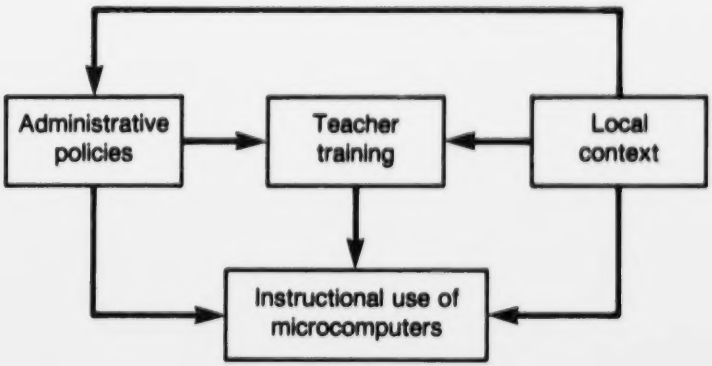

Fig. 1—Conceptual framework

derive a better understanding of how to stimulate teachers to use microcomputers for instruction from what is generally known about organizational change in the educational context.

POLICY MECHANISMS

The above assumptions allow us to draw on relevant literature on the broader subject of administrative mechanisms that encourage desired changes in practices. The literature on implementation, educational change, staff development, school "culture," effective schools, and teacher motivation reveals three recurrent themes regarding organizational incentives for microcomputer use: (1) administrative commitment and support, (2) involvement of teachers in innovation adoption, and (3) teacher incentives. We discuss each of these below and review suggestions from the literature concerning how administrators can help innovations to succeed and encourage greater teacher participation in staff development. We also discuss concrete implications of these findings for promoting increased instructional microcomputer use and more widespread participation in inservice computer training. We have drawn heavily on the small body of research that examines directly the determinants of microcomputer use (Becker, 1983, 1986; Mehan et al., 1985; Meister, 1984; Shavelson et al., 1984a,b; Sheingold, Kane, and Endreweit, 1983).

Administrative Commitment and Support

Previous research shows clearly that the level of commitment demonstrated by district and school administrators helps to determine the success of educational innovations. District administrators have control over such important factors as the availability of instructional materials and the compatibility of organizational arrangements with innovations (Gross, Giacquinta, and Bernstein, 1971), as well as the funds to purchase supplies and maintain equipment and access to expert resource personnel and resource centers that provide low-cost instructional materials (Futrell, 1983; Fullan and Pomfret, 1977; McLaughlin and Marsh, 1978). Districts can also provide teachers with the time to become familiar with an innovation (House, 1975).

Successful staff development also requires administrative commitment at the highest levels. Districts can structure incentives in ways that both encourage participation and conserve shrinking resources. For example, districts can provide staff development time for teachers by releasing students early on regularly scheduled days (Griffin, 1983),

or by scheduling activities during school hours (Office of Technology Assessment, 1982). In addition to offering traditional rewards such as salary credits, districts can also enhance staff development with readily accessible training materials or technical assistance (Griffin, 1983). Whatever the form of district support, the support mechanisms should provide visible evidence of the school district's commitment to the accomplishment of staff development objectives (Howey and Vaughan, 1983).

Commitment from *school* administrators is also necessary for successful implementation and staff development. Effective implementation requires a supportive school principal (Berman and McLaughlin, 1977, 1978; Fullan and Pomfret, 1977; Leithwood and Montgomery, 1982; McLaughlin and Marsh, 1978), usually one who provides instructional leadership (Purkey and Smith, 1983; McDonnell, 1983; Cohen, 1983). Administrators have control over important aspects of teachers' working conditions that may influence the success of an innovation (Mitchell, Ortiz, and Mitchell, 1983). Principals can also strengthen teachers' commitment to educational innovations by affording them public recognition and support, by involving them in decisionmaking (Thomas, 1978), and by establishing feedback mechanisms that stimulate interaction and problem identification, such as regularly scheduled project meetings (Fullan and Pomfret, 1977; McLaughlin and Marsh, 1978; Mitchell, Ortiz, and Mitchell, 1983).

The principal can also contribute to the success of staff development activities by providing leadership (Fullan and Pomfret, 1977; Griffin, 1983), strong personal commitment (Moore and Hyde, 1981; Jensen, Betz, and Zigarmi, 1978), resources (McDonnell, 1983), and even coverage of the classroom to give teachers the opportunity to participate in such activities (Griffin, 1983). Principals can also create opportunities for school staff development by promoting visits by outside experts, inviting speakers to faculty meetings, and scheduling inservice activities on shortened school days. Where staff development is initiated and provided by the district, principals can encourage their teachers to take advantage of district-sponsored activities (Moore and Hyde, 1981). McDonnell (1983) suggests that principals can play a greater role if they are provided with at least some discretionary resources. Such resources can be used to purchase instructional materials, create incentives to try new approaches, reward teachers who show particular initiative, and generally motivate the teaching staff. They can also provide principals with some flexibility in tailoring staff development programs to the needs of individual schools.

In summary, previous research suggests that commitment from district and school administrators is important for staff development and

for the adoption of innovations. In practice, however, the actions that districts and schools can take to promote these outcomes are inseparable and interactive. The best contribution that district and school administrators can make is to provide innovators with *technical support*, which gives them a clear signal that the innovation is taken seriously (McLaughlin and Marsh, 1978). Technical support implies all the necessary resources: equipment, supplies, training opportunities, and assistance for users of the innovation.

The research literature on instructional microcomputer use suggests specific forms of technical support that administrators can offer to encourage teacher training and instructional microcomputer use, including microcomputer hardware, educational software, inservice training, and readily available technical assistance (Meister, 1984; Sheingold, Kane, and Endreweit, 1983). Routine assistance is needed to support computer hardware, educational courseware, and especially, integration of computer activities into teachers' instruction curricula (Shavelson et al., 1984a,b). Indeed, technical support may be the critical factor underlying teachers' ability to improve their uses of computers (Stasz and Winkler, 1985). Administrators can also positively influence computer use by articulating plans for computer acquisition and implementation (Sheingold, 1981; Wilson, 1982) and by encouraging interested and willing personnel (Wilson, 1982).

A similar approach should be taken to promote computer staff development. Again, district administrators should provide needed resources, rather than attempt to exert direct control over the factors that determine the success or failure of training (Elmore, 1978). Administrators can, however, make staff development convenient, flexible, and responsive to teachers' needs (Fenstermacher and Berliner, 1983). Microcomputer-using teachers, for example, recommend that staff development consist of on-site meetings, during or after school hours, with as much hands-on practice as possible (Shavelson et al., 1984a).

Teacher Involvement

Teacher involvement is the second theme that emerges from the literature on educational change and innovation. Administrators may choose to involve teachers actively in training and implementation efforts, or they may impose programs from the top. Elmore's (1978) review of studies of educational change generally supports an organizational development model that promotes change in educational organizations by starting at the bottom of the organization, not at the top.

Change cannot be imposed without the active involvement of the participants (Elmore, 1978).

Teacher participation in decisionmaking is also important for effective program implementation (Fullan and Pomfret, 1977; Berman and McLaughlin, 1977, 1978; McLaughlin and Marsh, 1978). Teachers are likely to become more committed to an innovation if they are involved in problem-solving and decisionmaking and in developing new materials and teaching strategies (Crandall, 1983). Berman and McLaughlin (1977, 1978) conclude that teacher participation promotes implementation because it fosters a "sense of ownership."

Research on staff development also supports these conclusions. Teachers should have an active decisionmaking role in the planning and design of staff development activities (Purkey and Smith, 1983; Fenstermacher and Berliner, 1983; Jensen, Betz, and Zigarmi, 1978). By assuming this role, teachers can positively influence conditions that result in valued staff development activities. For example, Fenstermacher and Berliner (1983) contend that staff development is "sensible" when the activity is consistent with teachers' plans for their work, fits well with classroom circumstances, is timely, and is valued for its utility.

Staff development is also more valuable when it has clearly stated objectives that are related to the work demands of recipients. Thus, teachers should participate in the definition of objectives for staff development, and the initiation of staff-development activities should be a collaborative effort (Howey and Vaughan, 1983; Berman and McLaughlin, 1977, 1978; Vaughan, 1983). Staff development experiences devised solely by the central office staff can discourage school-initiated staff development and can be a major irritant to teachers (Moore and Hyde, 1981).

These findings indicate that *teacher input* should foster increased inservice training and microcomputer use. Teacher input is not unrelated to the presence of technical support; it has utility only insofar as it helps to relieve teachers' needs. More teachers will use microcomputers in districts where the impetus for such use comes from the teachers themselves *and* where microcomputers receive at least some administrative support (Shavelson et al., 1984b). However, wherever some technical support is provided, we expect that microcomputer use will increase along with teacher participation in decisions regarding microcomputer-related instructional programs and the acquisition of microcomputer hardware and software. Similarly, we expect that teacher involvement in planning and designing computer inservice training should encourage participation by the rest of the staff (Moore and Hyde, 1981).

Teacher Incentives

Incentives and rewards are believed to be key factors in encouraging both teacher training for and implementation of microcomputer-based instruction. Incentives that have been proposed to enhance teachers' attendance in computer staff development activities include incremental salary credits (Sheingold, 1981; Page and Wallig, 1983; Shavelson et al., 1984a), reimbursement for outside courses (Coburn et al., 1982), release time (NEA, 1982; OTA, 1982; Shavelson et al., 1984a), and new job titles and higher salaries for technically accomplished teachers (OTA, 1982). Other incentives have been suggested as means for encouraging computer use after training, including release time for curriculum development; letting teachers borrow computers over weekends, vacations, and summers (Sherman, 1983); and subsidizing teachers to permit them to develop courseware (OTA, 1982).

Although schools are continually adopting innovations—from new curricula to teacher career ladders to microcomputer-based instruction—few studies have examined how incentives actually foster teachers' acceptance of innovations. Berman and McLaughlin (1977) analyzed 27 descriptive studies of local project implementation to identify what distinguished successful from unsuccessful attempts at change. One factor was lack of coercion. Volunteerism on the part of teachers appeared to eliminate much of the "resistance to change" that is generally expected to occur with innovative projects, at least among the direct participants.

Lack of time is another factor frequently cited by teachers as a barrier to more effective implementation (Charters and Pellegrin, 1973; Berman and Pauly, 1975). A study of microcomputer-using teachers indicated that teachers had many more ideas about how to use computers than they had time to put into practice (Shavelson et al., 1984a). In another study, teachers mentioned that to use computers effectively, they need more time to plan for individualized use in their classroom, to review available software, and to observe their students' learning styles with the machines (Sheingold, Kane, and Endreweit, 1983).

Release time thus appears to be a positive incentive for educational innovation, while coercion is a negative incentive. Staff development has been shown to be affected similarly by these incentives (Fenstermacher and Berliner, 1983). Moore and Hyde (1981) described and compared the staff development activities in three school districts, looking at four types of incentives for participation in staff development activities: (1) substitute release time; (2) extra pay; (3) sabbatical leave; and (4) salary increases for educational attainment. They concluded that these incentives only weakly encouraged more widespread

teacher participation in staff development. Extra pay or salary credits for attendance in staff development induced participation, but not serious involvement or subsequent changes in behavior, and the expectation of extra pay undercut voluntarism. Moreover, compulsory staff development planned by central office staff was shown to be unproductive. This and other studies (e.g., Griffin, 1983; McLaughlin, 1975) conclude that extra pay and course credits are not particularly effective in increasing teacher commitment to staff development.

On the positive side, release time for participants has been found to be one of the important characteristics of successful inservice education programs. Berman and McLaughlin (1977, 1978) found that release time was a better strategy than extra pay for enlisting teachers' participation in staff development and fostering their willingness and ability to change. Berman and Friederwitzer (1981) found that teachers minimized the importance of long-term financial rewards resulting from participation in inservice programs, preferring release time from classroom duties and/or immediate reimbursement, rather than credits toward promotion or a higher pay bracket. Similar results were found by Jensen, Betz, and Zigarmi (1978). The teachers surveyed favored the following staff development incentives, in order of preference: credit for certificate renewal; expenses for meetings, workshops, projects, etc.; release time; college credit; and advancement on the salary schedule. Thus, *release time* appears to be a generally positive influence, and *extra pay* and *coercion* appear to be generally negative factors affecting staff development and use of innovations such as microcomputers.

Psychological literature on motivation and incentives, particularly as applied to schools, suggests why significant differences in computer use and staff development may result from different incentives and suggests some additional incentives that may encourage desired outcomes. Negative reinforcement (e.g., the withholding of rewards) has been shown to diminish interest and subsequent performance (Weiner, 1974). There is also an important distinction between intrinsic and extrinsic incentives. Extrinsic rewards include salaries and tangible job benefits (Griffin, 1983), prerogatives arising from promotion to a higher position (Lortie, 1975), and public recognition for participation in staff development (Schlechty and Whitford, 1983). Intrinsic, or "psychic," rewards consist of subjective valuations, including the satisfaction teachers derive from working with students (Lortie, 1975; Griffin, 1983), their sense of efficacy in meeting the needs of their students (Berman and McLaughlin, 1978; Darling-Hammond, Wise, and Pease, 1983), and improvements in work conditions provided by authorities in the system, such as release time for staff development (Griffin, 1983).

Consistent with the findings reviewed above, research on teacher motivation suggests that intrinsic incentives are more effective than extrinsic incentives in motivating teachers. Keaveny and Allen (1983) studied perceptions of satisfaction, performance, and effort among university faculty who were given an across-the-board pay raise. Contrary to expectations, faculty members who felt undercompensated anticipated that they would increase their levels of effort and performance despite undercompensation. The authors concluded that nonmonetary rewards, such as feelings of job satisfaction, strongly influence effort and performance outcomes. Lepper and his colleagues (Lepper, Greene, and Nisbett, 1973; Lepper and Greene, 1975) suggest that an important determinant of intrinsic motivation is challenge and curiosity. This suggests that *making a microcomputer available* for exploratory use by teachers—permitting teachers to borrow microcomputers when school is not in session, or placing them in teachers' lounges for experimentation—may encourage teachers to use them.

In addition, the use of extrinsic rewards may prove unwise where high motivation for task participation exists and the reinforcement dispensed is not contingent on performance. However, if initial intrinsic interest in an activity is very low, or if the activity is one that becomes attractive only when some initial level of mastery has been achieved, rewards may be necessary. This suggests that some extrinsic reward or incentive might be useful to motivate teachers who express little interest in staff development for microcomputer use or in using computers in the classroom. Once these teachers have developed some skill, they may also develop enough interest in microcomputers to continue with their training or to begin using them in the classroom.

Unfortunately, other research suggests that giving rewards for initial performance and then withdrawing them can undermine intrinsic interest in an activity (Deci, 1972; 1978). Deci (1978, p. 197) states, "Extrinsic rewards that are salient and contingent upon performing an activity tend to decrease people's intrinsic motivation for doing interesting activities." Thus, once the expectation of rewards is established, teachers may be unwilling to continue training without them.

On the other hand, rewards that convey information that a person is competent tend to enhance rather than undermine intrinsic motivation (Deci, 1978). According to Deci (1972), social reinforcers, such as verbal approval, may be beneficial to intrinsic motivation, provided their presentation is unambiguously related to task performance. Thus, *special recognition of microcomputer users*, with special approval for superior performance, may enhance interest in instructional computer use.

The psychological literature on motivation and incentives suggests some ways to encourage teachers to use microcomputers. Unfortu-

nately, distinguishing between "intrinsic" and "extrinsic" incentives may be difficult in practice. Extrinsic rewards that can be distributed differentially for teacher excellence or outstanding performance are scarce within the current reward structure of most schools (Griffin, 1983; Lortie, 1975; Schlechty and Whitford, 1983; Spuck, 1974). Those that do exist are most often distributed equally, with differentiation only according to a uniform set of criteria. Teachers are rarely provided with rewards such as merit pay increases, promotions, or professional development opportunities because of demonstrated excellence, assumption of extra responsibilities, or teaching in difficult situations.

Moreover, to the extent that schools administer extrinsic rewards, particularly monetary rewards, differentiation among employees is often based on continuing education, including staff development. Graduate study is necessary for a teacher who aspires to move to the ranks of administration (Pellegrin, 1976). As a result, intrinsic rewards may be more powerful than extrinsic rewards in most school systems (Griffin, 1983).

A final conceptual issue is raised by Mitchell, Ortiz, and Mitchell (1983), who point out that the distinction between extrinsic and intrinsic rewards is not clear-cut and that there is widespread confusion over the relationship between rewards and incentives. While both terms refer to the same work-related experiences, only those experiences that contribute significantly to an individual's sense of self-fulfillment, pleasure, or satisfaction are appropriately called rewards. Furthermore, rewards may or may not have an impact on subsequent performance. To significantly direct work effort, rewards must be anticipated as being contingent upon participation in, or performance of, particular work activities. Rewards anticipated as such become incentives, and the reward value of an experience is reflected in the magnitude of the pleasure or satisfaction it produces. On the other hand, the incentive value of this same experience is reflected in its effect on the worker's level or quality of effort.

In conclusion, Mitchell, Ortiz, and Mitchell (1983) provide a useful way to conceptualize the relationships among incentives, rewards, and microcomputer-related outcomes. Whether incentives are intrinsic or extrinsic is secondary to their impact, especially given the structure of rewards in schools. The magnitude of effort that teachers put into staff development and microcomputer-based instruction should indicate the value of incentives such as release time, extra pay, or special recognition. Teachers' responses to other policy variables indicating administrative commitment and teacher involvement should demonstrate the incentive value of these variables as well.

STAFF DEVELOPMENT

Staff development is the second theoretical concern in our conceptual framework relating administrative policies to microcomputer use. In its broadest connotation, staff development is an "enterprise of groups of teachers, often working in concert with specialists, supervisors, school administrators, counselors, parents, and many other persons who populate or are connected with the modern school" (Fenstermacher and Berliner, 1983, p. 3). Staff development is meant to advance the skills and knowledge of teachers in ways that should change their classroom behavior. It can occur in such diverse forms as district-sponsored formal workshops providing inservice education or small groups of teachers who get together on their own to pursue a common interest (Fenstermacher and Berliner, 1983).

Our conceptual framework assumes that administrative policies influence the nature and form of staff development in school districts. Specifically, administrative computer policies should influence whether teachers upgrade their computer skills and their methods for doing so. Where administrative policies fail to provide the necessary support, teachers' opportunities may be restricted to independent study, self-instruction, or informal networks of associates. These methods of staff development are important, and they contribute to a general understanding of the effect of different policies on the instructional use of computers, but we are currently concerned with *inservice training* as it is affected by administrative policies, and as it in turn influences instructional microcomputer use.

Some form of inservice training, from ad hoc workshops to ongoing series of specialized classes, is often found in districts where computers are used (Shavelson et al., 1984b; Stasz and Winkler, 1985). We shall attempt to relate the presence of such training, as well as its organizational characteristics, to training outcomes. If inservice training is to be encouraged, the level of *participation* by teachers is of particular interest, as is the representation in training of teachers of particular subjects and grades. Furthermore, variables measuring features of the staff development program should influence teachers' attendance. Important characteristics of staff development might include, for example, where development activities are held, how often they occur, who conducts them, and whether incentives for participation are offered (Shavelson et al., 1984a).

Staff development is also a general prerequisite to successful implementation of most educational innovations or changes in schools (Berman and McLaughlin, 1977, 1978; Purkey and Smith, 1983; Fullan and Pomfret, 1977). The provision of staff development opportunities to

teachers is itself a means of technical support, and the mere existence of a staff development program may act as an incentive for teachers to become involved with an innovation (Schlechty and Vance, 1983; Futrell, 1983). Consequently, we seek to identify the *incentive value* of providing inservice training for promoting instructional microcomputer use.

INSTRUCTIONAL USE OF MICROCOMPUTERS

The outcome variable in our conceptual framework is the *instructional use of microcomputers*. We assume that much of the unrealized potential of microcomputer technology lies in such use. Microcomputers are currently used in schools primarily to enhance computer literacy or to provide instruction in computer programming. Expansion of the use of microcomputers as an instructional tool in traditional subject matter courses could expose students of all ability levels to more advanced uses of microcomputers (Mehan et al., 1985). Moreover, computer applications in subject matter courses might better prepare students for using microcomputers in their jobs after they finish school (Cohen et al., 1983).

We further assume that a desirable goal for the use of microcomputers as a teaching tool is their *integration* into subject matter instruction (Meister, 1984; Sheingold, Kane, and Endreweit, 1983; Winkler et al., 1985). This means, initially, that they must be implemented as an institutionalized, regular, and continuing part of the school's operation (Berman and McLaughlin, 1977). Once such implementation has occurred, teachers will match the instructional tool to students, subject matter, instructional goals, and the classroom and school environment (Shavelson and Stern, 1981; Winkler et al., 1985). The forms of such microcomputer use will, of course, differ depending upon pedagogical goals, subject matter, and circumstances of use. Some teachers will choose to use microcomputers extensively for a variety of goals and objectives, while others may use them to enrich instruction, supplement particular lessons or tasks, or deliver drill-and-practice (Shavelson et al., 1984a).

The optimal methods for using computers for subject matter instruction are open to debate. Some researchers define "successful" computer use as "the extensive use of computers in a variety of subjects and in a variety of applications, by a large proportion of a school's students and teachers" (Meister, 1984, p. 3). Others see more narrow and specialized potential for microcomputer use in schools. Although there is some evidence that using computers in many ways is a beneficial

classroom technique (Cohen et al., 1983; Shavelson et al., 1984a), very few teachers now use microcomputers for teaching subject matter courses (Becker, 1983, 1986; NEA, 1982). Before controversies over pedagogy can be resolved, microcomputers must at least *be used* by the classroom teacher.

Thus, increasing the use of microcomputers for subject matter instruction is a necessary first step to evaluating their educational potential. The principal question now appears to be, How can more teachers be motivated to begin using microcomputers for subject matter instruction? We shall attempt to determine which administrative policies promote wider microcomputer use within school districts. We believe that once microcomputers are used by *more teachers, for more subjects, in more grades*, students will be given more opportunities to receive computer-based instruction of pedagogical value (Shavelson et al., 1984a; Stasz and Winkler, 1985; Winkler et al., 1985).

LOCAL CONTEXT

The final theoretical issue identified by our conceptual framework is that of the different relationships among administrative policies, inservice training, and use of microcomputers for subject matter instruction in different local contexts. McLaughlin and Marsh (1978) describe how implementation and continuation of innovations can differ according to teacher characteristics such as age and years of experience. Shavelson and Stern (1981) point out the additional effects of the instructional environment, including characteristics of schools, classrooms, and students, or teachers' instructional decisionmaking about an educational innovation.

Among the many potential contextual factors, minority composition of students appears to be an important characteristic of districts that may affect policies and outcomes (Shavelson et al., 1984a). Shavelson et al. (1984a) found that the percentage of minority students in the classroom was associated with the pattern of microcomputer-based instruction delivered: Remediation was emphasized to the exclusion of other applications in classrooms with high percentages of minority students (see also Becker, 1983). The proportion of minority students is also of interest for reasons of educational equity (Capper and Copple, 1985; Lipkin, 1983). The implication for the present study is that incentives and forms of support may be differentially effective in districts serving larger numbers of minority students, because they may help redress inequities in microcomputer use. Some policy mechanisms supporting microcomputer use may be especially effective where there

are larger numbers of minority students; but the opposite may also be true.

SUMMARY

Our conceptual framework views instructional use of microcomputers as a consequence of administrative policies, in conjunction with characteristics of the local context, such as the minority composition of students served. Inservice training, a form of staff development provided by the school district, is considered as intermediate between policies and teaching practices.

The major instructional outcome of interest here is the breadth of instructional microcomputer use, i.e., how widely microcomputers are used as a teaching tool across subject matter areas and grade levels. The effectiveness of administrative policies is measured here by the level of teacher participation in computer inservice training activities. The organization of training should also affect the extensiveness of participation.

The incentive value of a given policy determines the effort that teachers put into inservice training and the extent of microcomputer use for instruction. Previous research suggests several policy mechanisms with incentive value in this area, including demonstration of administrative commitment and support, involvement of teachers in decisionmaking, and incentives and rewards for teachers. Specifically, previous research suggests that:

- Commitment from district and school administrations should increase the breadth of microcomputer use for subject matter instruction. Increased use should occur when administrators articulate plans for such use and provide technical support in the form of hardware, educational software, inservice training, and readily available assistance.
- Instructional microcomputer use will increase when teachers participate in decisions concerning how microcomputers will be used for instruction and what equipment and educational courseware should be acquired.
- Incentives such as release time for curriculum development, opportunities for experimenting with the technology, and the availability of "loaner" computers should promote the use of microcomputers for instruction. These intrinsic incentives may be more effective than extrinsic incentives such as salary credit, promotions, and special recognition.

Similarly, the literature suggests the following:

- Participation in staff development should increase as administrators make such programs responsive to teachers' needs. Staff development is responsive when it is accessible and consistent with teachers' classroom activities.
- Participation will increase when teachers are included in the planning and design of computer staff development activities. As the content of computer staff development reflects their interests and needs, participation will increase.
- Staff development will become more widespread when teachers are provided with incentives such as salary credit, the possibility of promotion, release time, and special recognition. Extrinsic incentives may be more effective for encouraging staff development than intrinsic incentives. Coercion, though possibly effective for improving attendance in staff development, will ultimately undermine teachers' use of microcomputers for instruction.

The remainder of this report describes our empirical research on whether these potential administrative actions, singly or in combination, indeed encourage teachers to gain proficiency with microcomputers and to use them for subject matter instruction.

III. NATIONAL SURVEY OF COMPUTER-USING DISTRICTS

To evaluate the effectiveness of alternative computer policies, we conducted a telephone survey of computer supervisors in public school districts throughout the United States. This section describes the survey methods and sample, analyzes the role that various administrative policies play in encouraging more widespread inservice training and microcomputer use, and reports the survey results. It also discusses how the effects of administrative policies differ depending on the proportion of minority students in a district.

SURVEY METHOD

During February and March 1985, trained interviewers surveyed microcomputer supervisors in public school districts that owned microcomputers, using a structured, closed-ended questionnaire developed for this study.[1] (The questionnaire is reproduced in the Appendix.) We sought information about the availability of microcomputers and courseware, inservice training programs, and various incentives and forms of technical support. We also sought general information regarding microcomputer use in each district, as well as respondents' estimates of the level of teacher participation in inservice training. Each interview lasted about 20 minutes.

Sample Selection

Survey participants were selected at random from a comprehensive listing of designated microcomputer supervisors in K–12 public school districts.[2] Some respondents were microcomputer-using teachers who served as resource persons in their district, but most were district administrators with official designation as computer supervisors. Previous research (Shavelson et al., 1984a) has indicated that such individuals tend to be "computer buffs" or successful computer-using teachers

[1]Several of the items in the questionnaire were adapted from Lockheed et al. (1983).

[2]Names, addresses, and phone numbers of respondents, as well as descriptive information about each district (e.g., enrollment, minority composition) were provided by Quality Educational Data (QED) of Denver, Colorado, a firm that tracks microcomputer use in public schools. This firm also provided the sampling frame used in the Johns Hopkins surveys of school uses of microcomputers (Becker, 1983, 1986).

who have left the classroom to assume administrative duties. They are usually very knowledgeable about district and school policies supporting inservice training and microcomputer use, as well as about the general condition of microcomputer-based instruction in their districts. Many of them provide inservice training to other teachers in the district (Shavelson et al., 1984a).

Characteristics of the Sample

Our starting sample consisted of computer supervisors in 175 districts. Four of the respondents proved ineligible because their districts did not currently use microcomputers. We completed interviews with 155 of the remaining 171 contacts, for a 91 percent response rate.

Districts in the final sample were located in 42 states. The greatest concentrations were in north central and southern states (Table 3.1);

Table 3.1

LOCATIONS AND CHARACTERISTICS OF DISTRICTS

Characteristic	Percent	N
Region		
Northeast	19.4	30
North central	38.7	60
South	27.1	42
West	14.8	23
Location		
Urban	27.2	43
Suburban	38.1	59
Rural	34.2	53
Student enrollment		
Under 300	9.7	15
300–999	16.1	25
1,000–2499	19.4	30
2,500–4999	18.1	28
5,000–9999	11.6	18
10,000–24,999	13.5	21
25,000 or more	11.6	18
Size of teaching staff		
Under 25	11.6	18
25–99	23.2	36
100–249	23.9	37
250–499	11.0	17
500 or more	30.3	47

urban, suburban, and rural districts are all well represented. Student enrollments in these districts range from very small to very large, and the sizes of the teaching staffs vary accordingly.[3]

Student characteristics, profiled in Table 3.2, show that nearly two-thirds of the students served in these districts are white; there is also considerable variation in wealth, as indicated by the distribution of their Orshansky percentile (the fraction of students under the poverty guideline in each district).

Nature and Limitations of the Analysis

Our conceptual framework identifies administrative policies as independent variables affecting teacher training and microcomputer use (the dependent variables). Most of the independent variables indicate whether particular administrative policies are absent or present (e.g., whether teachers can receive release time to attend training, whether training is held in teachers' schools); some indicate a continuous measure (e.g., the ratio of microcomputers to teachers). Variables representing levels of inservice participation and microcomputer use for subject matter instruction were obtained from respondents' estimates.

We use correlational analyses to explore the simple relationships between policy variables and outcomes, followed by multiple-regression analyses to determine the relative importance of administrative policy variables. All of the analyses in this section employ the district as the unit of analysis. In interpreting these analyses, it should be kept in mind that the results reflect relationships among policy variables and outcomes within a sample of districts in which computers are now being used. They may thus not be representative of all school districts.

Table 3.2

CHARACTERISTICS OF STUDENTS IN DISTRICTS

Characteristic	Mean	Standard Deviation	N
Percentage of white students	67.7	36.6	155
Percentage of black students	11.0	20.6	155
Percentage of Hispanic students	5.2	13.2	155
Orshansky percentile[a]	14.9	13.4	155

[a]Percentage of students under federal poverty guidelines as a percentage of total school-age children in the district.

[3]Average enrollment in these districts is 13,956 (standard deviation of 42,353); the average teaching staff numbers 710 (standard deviation of 1,628).

ADMINISTRATIVE POLICIES SUPPORTING MICROCOMPUTERS

Technical Support

The provision of adequate technical support is an important way of demonstrating administrative commitment to an innovation. Teachers must have access to a sufficient number of microcomputers if they are to use them as an instructional tool. The numbers of microcomputers in our survey districts vary considerably,[4] but simple numbers may be a misleading indicator of microcomputer accessibility. A better measure is the ratio of microcomputers to teachers, along with its inverse, the number of teachers per microcomputer. The mean value of this ratio is 0.43 (standard deviation of 0.26), or 2.3 teachers per microcomputer. The corresponding mean ratio of microcomputers to students is 0.03 (standard deviation of 0.03), or 33.3 students per microcomputer.

Respondents were also asked to indicate whether several other forms of technical support were available to teachers in the district, and their responses suggest that considerable technical assistance is available (Table 3.3). Most of the districts purchase courseware needed for the

Table 3.3

AVAILABILITY OF TECHNICAL SUPPORT IN DISTRICTS

Form of Technical Support	Percent	N
Courseware acquisition by the district		
Absent	4.5	7
Present	95.5	147
Assistance with hardware		
Absent	5.2	8
Present	94.8	147
Assistance with locating and evaluating educational courseware		
Absent	20.0	31
Present	80.0	124
Assistance with integrating microcomputers		
Absent	34.2	53
Present	65.8	102
Resource persons		
Absent	36.1	56
Present	63.9	99

[4]The mean number of microcomputers in each district in the sample is 252 (standard deviation of 789), which is skewed by a small number of districts with large numbers of microcomputers. The median number of microcomputers is 35.

use of microcomputers for subject matter instruction, as well as providing various forms of necessary routine assistance. According to district computer supervisors, most districts assist teachers with hardware problems, help them locate and evaluate courseware, and assist them in integrating microcomputers into their teaching. Survey respondents or their staffs are often the source of such support. In addition to such centralized assistance, about two-thirds of the districts have resource persons in most or all of the schools.

Inservice training in microcomputer use is an additional form of needed assistance. As Table 3.4 shows, most of the districts provide inservice computer training to teachers, the median amount available being 25 hours per year. Microcomputer supervisors also report considerable hands-on computer use, which is believed to improve the quality of training (the median amount of hands-on computer time was reported as 75 percent).

Other organizational differences in staff development reflect at least some suggestions made in the literature (Table 3.4). Participation tends to be voluntary, although many districts have at least some involuntary component. Generally, training programs are accessible in

Table 3.4

FEATURES OF INSERVICE TRAINING PROGRAMS

Feature	Percent	N
Inservice microcomputer training		
Absent	19.4	30
Present	80.6	125
Form of participation		
Involuntary	35.5	44
Voluntary	64.5	80
Location		
Not held in teachers' schools	27.2	34
Held in teachers' schools	72.8	91
Frequency		
Not regularly scheduled	36.0	45
Regularly scheduled	64.0	80
Curriculum		
Advanced classes not provided	44.0	55
Advanced classes provided	56.0	70
Instructors		
Not taught by teachers in the district	49.0	76
Taught by teachers in the district	51.0	79

teachers' own schools and occur on a regular basis. Advanced classes, which suggest a flexible curriculum reflecting the needs of different teachers, are offered in more than half of the districts. Staff development, which is also believed to be more responsive if taught by teachers in the district, takes place in approximately half of the schools.

Finally, we asked respondents whether the district had developed written plans for student microcomputer use. Such plans, which indicate administrative commitment to computers, were present in 63 percent of the districts surveyed.

Teacher Involvement in Decisions

Respondents were asked to characterize the level of teacher involvement in decisions about (1) how microcomputers are to be used for instruction and (2) the content and organization of inservice training in microcomputer-based instruction. Response alternatives were "not very," "somewhat," "moderately," and "highly involved." Teachers' involvement in decisionmaking about *instructional use* of computers was reported as moderate to high (a mean of 3.3 on a four-point scale, standard deviation of 0.9). Respondents reported less teacher involvement in decisionmaking about *inservice training* (a mean of 2.8 on a four-point scale, standard deviation of 1.0).

Incentives and Rewards for Teachers

Respondents were asked to indicate the availability of several types of extrinsic and intrinsic incentives to participate in inservice training and use of microcomputers for instruction. Responses suggest that provision of incentives for microcomputer use or for participation in training programs is rare (Table 3.5). Among districts with inservice training, the most common incentives are "special recognition" (e.g., certificates and "pats on the back") and release time to take inservice workshops. The most frequent incentive to *use* microcomputers is recognition from administrators and peers, followed by release time. Higher pay for inservice training is much more common than extra pay for using the technology. Promotional opportunities are generally administrative (Smoley and Schaffarzick, 1984), and they too are scarce.

"Intrinsic" incentives are more common. Of 155 districts surveyed, 120 (77.4 percent) allow teachers to borrow microcomputers when school is not in session, and 83 (53.5 percent) offer teachers exclusive use of a computer in their schools for purposes of familiarization.

Table 3.5

PERCENT OF DISTRICTS OFFERING VARIOUS INCENTIVES

Incentive	Inservice Training[a]		Microcomputer Use	
	Percent	N	Percent	N
Higher pay				
Not offered	64.2	79	91.6	142
Offered	35.8	44	8.4	13
Possibility of advancement to an administrative position				
Not offered	87.2	109	89.0	138
Offered	12.8	16	11.0	17
Release time				
Not offered	59.2	74	72.3	112
Offered	40.8	51	27.7	43
Special recognition				
Not offered	52.8	66	42.6	66
Offered	47.2	59	57.4	89
Guarantee of computer or software upon completion of training				
Not provided	64.8	81	—	—
Provided	35.2	44	—	—

[a]Entries are frequencies and Ns for districts having inservice training.

INCENTIVE VALUE OF ADMINISTRATIVE POLICIES

Administrative policies associated with greater participation in training and increased use of microcomputers have positive incentive value; those that minimize these outcomes have negative incentive value. Most of the administrative variables we examined would be expected to have positive value. In general, as technical support increases, as teachers are more involved in decisions, and as incentives are provided, more teachers should partake of inservice training and use microcomputers for subject matter instruction.

To estimate incentive value, we first determined the correlations between policy variables and outcomes. Then, to test the effect of each of these independent variables while holding the others constant, we specified a multiple-regression equation for each outcome measure that included all of the policy variables of interest, as well as variables that account for differences among districts. We also examined the influence of minority student composition on relationships among policies, inservice training, and microcomputer use for subject matter instruction. These models indicate which of the factors known to be

important are most closely related to microcomputer use, other things being equal. They also show how much variance in each measure of microcomputer use can be explained by the predictors.

Participation in Inservice Training

Computer supervisors were asked to estimate the percentage of the teaching staff who had received inservice computer training and to rate whether elementary teachers and math, science, and English teachers were represented "poorly," "moderately," or "well" in inservice training.

Mean values of these variables, presented in Table 3.6, suggest that a fairly large number of teachers have received at least some inservice computer training. Mathematics and elementary teachers are best represented, and English teachers are least represented; however, even English teachers' representation is judged "moderate" overall. The percentage of the teaching staff receiving training seems impressive, but it is somewhat inflated because more than one-third of the districts have training that is at least partly involuntary (Table 3.4). To stabilize the variance, we transformed respondents' estimates of teacher percentage to their logarithmic values in the following correlations and regressions. These analyses then inform us of which factors are associated with more or less participation in training by the teaching staff.

Correlates of Participation. Significant, though modest, relationships between administrative policy variables and inservice participation are apparent from Table 3.7, which also presents correlations between organizational features of training and inservice participation. More teachers participate in inservice computer training as the number of computers per teacher increases and as resource persons are made

Table 3.6

PARTICIPATION IN INSERVICE COMPUTER TRAINING

Measure	Mean	Standard Deviation	N
Percentage of teachers receiving training	60.7	30.5	124
Representation*			
Elementary teachers	2.6	0.6	125
Math teachers	2.7	0.6	123
Science teachers	2.2	0.8	123
English teachers	2.0	0.8	123

*Measured on a three-point scale, where higher values indicate greater representation.

Table 3.7

CORRELATES OF PARTICIPATION IN COMPUTER INSERVICE TRAINING

Form of Support	Percentage of Teachers Trained (log)	Teacher Representation			
		Elementary	Math	Science	English
Microcomputers per teacher	.35***	.15	.09	.28**	.22*
District courseware	−.05	.08	.03	−.05	.18
Hardware assistance	.04	.20*	.06	.04	.13
Courseware assistance	−.09	.12	−.03	.16	.05
Integration assistance	.15	.14	−.10	.10	.06
School resource persons	.22*	.14	.07	.03	.12
District plan	.02	.05	−.01	.17	.20*
Teachers help decide inservice training	.28**	.13	.08	.24**	.19*
Incentives for inservice					
Release time	.20*	.09	.02	−.03	.15
Higher pay	.12	.04	.03	.10	.23*
Promotion to administration	.06	.14	.05	.00	.14
Hardware/software guaranteed	.24**	.01	.04	−.07	.07
Special recognition	.01	.09	.12	.06	.12
Computer set aside for teachers	.01	.00	.05	.05	−.02
Teacher may borrow computers	.11	.04	.04	−.09	.08
Features of inservice					
Voluntary participation	−.14	−.19*	.07	−.01	−.14
Held in teachers' schools	.22*	−.01	−.09	.14	.08
Regularly scheduled	−.03	.10	.10	.20*	.11
Advanced training provided	.08	.27**	.09	−.04	.16
Taught by teachers	.16	.00	−.01	.05	.18*
Percent time "hands on" (log)	−.11	.18	.02	.23*	−.04
Number of hours available	.06	.14	.09	−.04	.11

NOTES: Correlations are based on responses from 125 districts having inservice computer training. Entries are point-biserial correlations, except for those for "Microcomputers per teacher," "Teachers help decide," and "Hours and percent of hands-on training time," which are Pearson correlations. N's range from 122 to 125 due to missing data. (*** = $p < .001$; ** = $p < .01$; * = $p < .05$.)

available in teachers' schools. Teacher participation in deciding the content and form of inservice training is also important, as are release time to take classes and guaranteed access to microcomputers or software upon completion. One organizational feature of inservice training stands out: The level of participation increases when inservice training occurs at the teachers' own schools.

These correlations also suggest that the sensitivity of teachers of different grade levels and subject matter to certain administrative policy variables may vary. Elementary teachers respond to the availability of district assistance in installing or maintaining equipment and to organizational aspects of inservice training, including the availability of advanced inservice training classes and more hands-on training time. Fewer elementary teachers participated when participation was voluntary.

Some distinctive relationships were also found for teachers of science and English. More microcomputers per teacher and teacher participation in deciding the content and form of inservice training increase participation of both groups. English teachers also respond in greater number when the district has a written plan and teachers help decide how computers will be used. Regularly scheduled inservice training, with a larger amount of hands-on time, increases participation by science teachers, whereas English teachers participate more when the district offers higher pay for taking inservice training and when training classes are taught by members of the teaching staff.

Explaining Differences in Participation. To test the independent effects of various administrative policy variables, we used multiple regression. For each measure of inservice participation, we specified a model that included all relevant policy variables, as well as district characteristics that potentially affect administrative computer policies and outcomes. These are (1) size, as indicated by student enrollment; (2) wealth, as indicated by the percentage of students under the poverty guideline in these districts; and (3) percentage of minority (nonwhite) students served. In these equations, administrative policy variables are treated as dummy variables if dichotomous, coded 1 if present or 0 if absent.

The multiple-regression equation predicting the degree of teacher participation in inservice training is presented in Table 3.8. This model explains a significant though modest portion of the variance in the outcome measure. District characteristics included in the equation do not independently predict the level of teacher participation in inservice training, but when these characteristics are controlled, the number of microcomputers per teacher in the district is significant. As the number of microcomputers available to teachers increases, more of the

Table 3.8

REGRESSION RESULTS FOR PERCENTAGE OF TEACHERS RECEIVING INSERVICE TRAINING

Variable	b	t
Constant	3.99	10.82***
Proportion of minority students	0.01	0.03
Number of students in district	0.00	0.26
Orshansky percentile (log)	0.00	0.00
Microcomputers per teacher	0.75	2.83**
Courseware purchased by the district	−0.40	−1.12
Assistance with hardware available	−0.12	−0.34
Assistance with courseware available	−0.43	−2.01*
Assistance with integration available	0.23	1.26
Resource person in schools	0.15	1.29
Written district plan	−0.01	−0.05
Teachers involved in training decisions	0.12	1.75
Incentives for inservice training		
Release time	0.15	1.06
Extra pay	0.19	1.40
Promotions	−0.05	−0.25
Guarantee of hardware/software	0.24	1.49
Special recognition	−0.22	−1.58
Computer set aside for teacher experimentation	0.01	0.11
Teachers may borrow computers	0.10	0.60
Features of inservice training		
Voluntary	−0.11	−0.80
Held in teachers' schools	−0.01	−0.05
Scheduled regularly	−0.01	−0.04
Advanced classes	0.03	0.19
Taught by teachers	0.11	0.78
Percentage of time "hands on" (log)	−0.16	−1.46
Number of hours available	0.00	0.33
Adjusted R^2 = 0.16		
F = 1.87*		
N = 114		

NOTES: Percentage of teachers receiving training is transformed to its logarithmic value in this regression. Most predictor variables are dummy variables with the absence of the policy as referents, except where a continuous measure is indicated. See accompanying text for details. (*** = $p < .001$; ** = $p < .01$; * = $p < .05$.)

teaching staff participate in inservice training programs. None of the other factors in this model induces more widespread participation, however.

The increased availability of hardware for teachers is significantly associated with the level of participation in inservice training, even when size, wealth, and minority composition of students served are taken into account. Thus, the ratio of microcomputers to teachers does not reflect merely differences in district resources indicated by these variables.[5]

Other things being equal, the availability of assistance from the district in locating and evaluating courseware *negatively* affects participation in inservice training. While this result seems surprising, we observe that learning about available software is a major topic and need in inservice training (Shavelson et al., 1984a). These results suggest that as assistance becomes routinely available, teachers may have less interest in or need for formal inservice training.

Using the same multiple-regression model, we sought to determine the relative importance of these factors to the representation of elementary, science, math, and English teachers in inservice computer training. The models were, on the whole, not very successful; only the model predicting attendance by elementary teachers achieved statistical significance (Table 3.9). This model, which explains 13 percent of the variance in the outcome measure, demonstrates the incentive value of promotions and of two organizational features of staff development—increased hands-on computer time during training and mandatory participation.

These findings suggest that fewer elementary teachers are willing to participate in voluntary inservice training unless a clear extrinsic incentive is provided. There are a number of possible explanations for this. Elementary teachers may be generally less senior in professional stature than secondary teachers and therefore more responsive to the possibility of promotion. Alternatively, elementary teachers may have less reason to participate in inservice training without a clear reason for doing so. Unfortunately, our data do not allow such possible explanations to be disentangled.

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[5]The microcomputer/teacher ratio does not covary significantly with these district characteristics. Zero-order correlations between this variable and the variables measuring district characteristics are as follows: with the number of students in the district, $r = -.02$; with the Orshansky percentile (log), $r = -.09$; with the proportion of minority students, $r = -.05$. These correlations are not statistically significant.

Table 3.9

REGRESSION RESULTS FOR INSERVICE REPRESENTATION OF ELEMENTARY TEACHERS

Variable	b	t
Constant	0.29	0.46
Proportion of minority students	0.35	1.97
Number of students in district	−0.00	−1.08
Orshansky percentile (log)	0.07	1.04
Microcomputers per teacher	0.28	1.25
Courseware purchased by the district	0.13	0.44
Assistance with hardware available	0.31	1.01
Assistance with courseware available	0.07	0.42
Assistance with integration available	−0.10	−0.65
Resource person in schools	0.14	1.38
Written district plan	−0.14	−1.14
Teachers involved in training decisions	0.02	0.32
Incentives for inservice training		
Release time	0.12	1.00
Extra pay	−0.01	−0.04
Promotions	0.39	2.17*
Guarantee of hardware/software	−0.21	−1.58
Special recognition	0.03	0.28
Computer set aside for teacher experimentation	0.00	0.04
Teachers may borrow computers	0.17	1.25
Features of inservice training		
Voluntary	−0.24	−2.09*
Held in teachers' schools	−0.11	−0.87
Scheduled regularly	0.06	0.50
Advanced classes	0.22	1.87
Taught by teachers	−0.15	−1.23
Percentage of time "hands on" (log)	0.28	3.08**
Number of hours available	0.00	0.23
Adjusted R^2 = 0.13		
F = 1.70*		
N = 115		

NOTES: Representation of elementary teachers is measured on a three-point scale, where higher values indicate greater representation. Most predictor variables are dummy variables with the absence of the policy as referents, except where a continuous measure is indicated. See accompanying text for details. (*** = $p < .001$; ** = $p < .01$; * = $p < .05$.)

Breadth of Microcomputer Use

The breadth of microcomputer use in each district was assessed by asking respondents to indicate whether microcomputers were used in particular grades and subjects in their districts. As these respondents generally provide training and assistance to teachers who use microcomputers, they generally know whether such applications exist (Shavelson et al., 1984a). Specifically, respondents were asked whether microcomputers were used for instruction in math, science, social science, and English in any elementary (K–6) and secondary (7–12) classes. Affirmative responses were summed to create an index of breadth of microcomputer use across subjects and grade levels. The index can vary from 0 to 8, with higher values indicating more widespread use of microcomputers. The mean value of this index was found to be 4.85 (standard deviation of 2.03), indicating that microcomputers were used for instruction, on average, in about five of the eight possible combinations of subject matter courses and grades.

We also asked respondents to estimate the percentage of the teaching staff using microcomputers for subject matter instruction. Responses indicated that about one-third of the teachers in districts surveyed reportedly used microcomputers (mean of 31.8 percent, standard deviation of 25.0). This number seems high in relation to other recent surveys (Becker, 1983, 1986) and may be inflated by respondents' inclusion of computer literacy and programming applications. Although these measures of microcomputer use are well correlated, indicating that as microcomputers are used for instruction in more subjects and grades, more teachers use them, we examine "breadth of use" as the primary indicator of districtwide microcomputer use.

Correlates of Microcomputer Use. Correlations between each of these measures of microcomputer use and administrative policy variables are shown in Table 3.10. Results for both variables are remarkably consistent and show that nearly all of the administrative policy variables significantly broaden microcomputer use. Variables that are unrelated to microcomputer use include the availability of district assistance with hardware, the possibility of promotions for microcomputer use, availability of microcomputers for experimentation, and allowing teachers to borrow microcomputers. None of these appears to diminish use.

Predicting Microcomputer Use. The magnitude of the associations suggests that more microcomputers per teacher, technical assistance in integrating microcomputers into the curriculum, and the availability of inservice training may be especially important for increasing the use of microcomputers across subjects and grades.

Table 3.10

CORRELATES OF MICROCOMPUTER USE

Item	Use in Primary and Secondary Subjects[a]	Percentage of Teachers Using Computers (log)
Microcomputers per teacher	.27***	.44***
District courseware	.20*	.16*
Hardware assistance	.07	.10
Courseware assistance	.23**	.20*
Integration assistance	.40***	.18*
School resource persons	.20*	.21*
District plan	.24**	.03
Teachers decide computer use	.16*	.25**
Release time	.02	−.04
Higher pay	.20*	.18*
Promotion to administration	.10	−.09
Computer set aside for experimentation	.04	−.01
Computer take-home privileges	.06	.05
Special recognition	.19*	.19*
Inservice training in district	.33***	.21*

NOTES: Correlations are based on responses from 155 districts; Ns range from 152 to 155 due to missing data. Entries are point-biserial correlations, except for those for "Microcomputers per teacher" and "Teachers help decide."

[a]Scale indicates usage in elementary and secondary math, science, social studies, and English (language arts). Values range from 0 to 8. (*** = $p < .001$; ** = $p < .01$; * = $p < .05$.)

Indeed, when the variable measuring the breadth of microcomputer use is regressed on variables representing district characteristics and administrative policies, these three predictors are uniquely significant (Table 3.11). This model, which explains over one-quarter of the variance in the breadth of microcomputer use, clearly demonstrates that microcomputer use increases with increased availability of microcomputers. It also shows that when the availability of the technology is accounted for, microcomputers are used in more subjects and grades when teachers receive routine, centralized assistance in integrating the microcomputer into their curriculum of instruction.

Even when these (and other) factors are accounted for, the availability of inservice training acts as an incentive for helping this educational innovation to take hold. Finally, as extra pay becomes available, computer use broadens. This extrinsic incentive may encourage teachers in more subjects and grades to use microcomputers for instruction, above and beyond any technical support.

Table 3.11

REGRESSION RESULTS FOR BREADTH OF MICROCOMPUTER USE

Variable	b	t
Constant	1.91	1.47
Proportion of minority students	0.02	0.04
Number of students in district	0.00	2.31*
Orshansky percentile (log)	−0.21	−1.08
Microcomputers per teacher	1.20	2.00*
Courseware purchased by the district	1.34	1.93
Assistance with hardware available	−0.76	−1.04
Assistance with courseware available	−0.63	−1.26
Assistance with integration available	1.23	2.79**
Resource person in schools	−0.08	−0.31
Written district plan	0.60	1.85
Teachers involved in computer use decisions	0.21	0.98
Incentives for inservice training		
Release time	−0.61	−1.07
Extra pay	1.28	2.22*
Promotions	0.53	1.08
Special recognition	0.20	0.62
Computer set aside for teacher experimentation	−0.15	−0.48
Teachers may borrow computers	−0.04	−0.10
District provides inservice training	1.31	3.13**
Adjusted R^2 = 0.26		
F = 3.85***		
N = 143		

NOTES: Breadth of use is an eight-point scale, with higher values indicating greater use across subjects and grades. All predictor variables are dummy variables with absence of the policy as referents, except "Teachers involved in decisions" (coded on a four-point scale where 1 = not very involved and 4 = highly involved), and "Microcomputers per teacher." (*** = $p < .001$; ** = $p < .01$; * = $p < .05$.)

The foregoing relationships hold when student enrollment, minority composition, and wealth are taken into account, although microcomputer use tends to broaden across grades and subjects on its own in districts with larger student enrollments. That is, size is a district characteristic that independently influences how widely microcomputers are used for instruction. The administrative policies that broaden microcomputer use do so even as this and other differences among districts are controlled, however. Context and policy are not collinear; none of

these district characteristics is significantly correlated with the statistically significant administrative policy variables.[6]

Moderating Conditions

Having determined the importance of technical support and other administrative variables, we next examined whether the effects of administrative policy variables depend on local context. Once the independent effects of district characteristics and administrative policies are taken into account, a policy may differ in effectiveness across categories of districts or students served. Because there is reason to believe that computer learning activities may differ for minority children (Shavelson et al., 1984a,b), we first examined whether the incentive value of administrative policies supporting microcomputer use differs according to the minority composition of students served.

In statistical terms, minority composition could *interact* with administrative policy variables; for example, a form of technical support (e.g., assistance with courseware) may be especially important for districts with large numbers of minority students. To investigate such possibilities, we recomputed the multiple-regression equations predicting the percentage of teachers receiving inservice training and the breadth of computer use. We created cross-product terms between minority composition and all policy variables, including organizational features of staff development, and included these as predictor variables in the regression equations. These interaction terms are included in addition to variables from the earlier equations measuring policies and district characteristics. The interaction terms then tell us whether policies differ in effectiveness according to student composition, *net of* effects attributable to district characteristics or policies alone (Cohen and Cohen, 1975).

We computed separate multiple-regression equations accounting for black and Hispanic student composition, respectively, including all interaction terms appropriate to each case. The addition of interaction terms, however, did not improve our ability to predict the percentage of teachers receiving inservice training. Indeed, in the equation for black students, the overall model became statistically nonsignificant, while the amount of variance accounted for in the outcome measure fell from an R-square of 0.16 to 0.14. Similarly, the addition of interaction

[6]Zero-order correlations among variables representing size, wealth, and minority composition and the statistically significant predictors (microcomputers per teacher, presence of inservice training, availability of assistance with integrating computers, and extra pay for using computers) range from $r = -.17$ to $r = .14$ and are not statistically significant.

terms to the equation examining the mediating effects of Hispanic composition on teacher participation did not yield interpretable results.

On the other hand, the inclusion of minority interaction terms improves our understanding of incentives to enhance microcomputer use in more subjects and grades. Table 3.12 shows that adding interaction terms with black student composition provides additional explanatory power over the equation that included only district characteristics and administrative policy variables (Table 3.11). The equation of Table 3.12 explains 31 percent of the variance in breadth of use, compared to 26 percent from Table 3.11. The regression model that accounts for interactions between administrative policies and Hispanic composition is not as successful, however. Adding these terms to the equation provides no additional explanatory power; in fact, the variance accounted for falls to 24 percent from 26 percent. Previously significant findings are attenuated, while none of the interaction terms is significant in itself.

In the case of black student composition, the new model causes the relative importance of some predictive factors to change. A larger number of microcomputers per teacher still increases the breadth of microcomputer use, but the inclusion of interaction terms decreases the importance of other previously significant policy variables. The availability of assistance with integrating microcomputers diminishes in importance ($p < .08$), as does the provision of inservice training ($p < .07$) and extra pay for computer use ($p < .06$).

These results are supplanted, however, by some new findings. The inclusion of these interaction terms causes a new "main effect" to emerge: Microcomputer use broadens as the district purchases courseware for teachers to use. The provision of courseware, in addition to the accessibility of hardware, thus emerges as a significant form of technical support, independent of minority status. We also now observe some significant interactions between policy variables and the proportion of black students in the district which indicate that the importance of these variables *depends on* the proportion of black students.

These interactions are apparent for three variables previously seen as significant predictors of microcomputer use: First, the proportion of black students interacts with the availability of routine assistance in integrating microcomputer use into ongoing instruction. The availability of such assistance broadens computer use *especially when more black students are served.* Second, the importance of inservice training also depends upon the proportion of black students. Provision of inservice training broadens computer use *particularly* when there are relatively more black students in the district. Finally, "special

Table 3.12

REGRESSION RESULTS FOR MICROCOMPUTER USE, INCLUDING INTERACTION TERMS

	Black Students		Hispanic Students	
Variable	b	t	b	t
Constant	1.93	1.30	2.08	1.34
Proportion of black students	5.35	0.78	—	—
Proportion of Hispanic students	—	—	−13.37	−0.08
Proportion of other minority students	−0.05	−0.11	0.06	0.11
Number of students in district	0.00	1.77	0.00	1.27
Orshansky percentile (log)	−0.24	−1.13	−0.21	−1.00
Microcomputers per teacher	1.42	2.13*	0.81	1.19
Courseware purchased by the district	1.98	2.26	0.96	1.21
Assistance with hardware available	0.20	0.25	−0.54	−0.62
Assistance with courseware available	−0.39	−0.71	−0.66	−1.24
Assistance with integrating computers	0.92	1.78	1.39	2.87**
Resource person in school	−0.36	−1.25	−0.02	−0.07
Written district plan	0.45	1.24	0.39	1.06
District provides inservice training	0.88	1.89	1.24	2.76**
Teachers involved in computer decisions	−0.06	−0.26	0.27	1.12
Incentives				
Release time	−0.66	−1.65	−0.53	1.34
Extra pay	1.22	1.97	1.01	1.54
Promotions	0.47	0.77	0.55	1.02
Special recognition	0.76	1.97	0.24	0.65
Computer set aside for teachers	0.19	0.53	−0.15	−0.43
Teachers may borrow computers	0.10	0.19	−0.17	−0.39
Interaction terms with black/Hispanic				
Microcomputers per teacher	−7.59	−1.17	26.88	1.53
Courseware purchased by the district	−4.50	−0.85	30.89	1.34
Assistance with hardware available	−7.29	−1.21	−13.95	−0.09
Assistance with courseware available	−5.41	−1.87	−5.77	−0.37
Assistance with integration available	6.76	2.40*	0.06	1.00
Resource person in schools	−1.62	−1.04	−0.53	−0.07
Written district plan	3.02	1.39	4.95	1.13
Inservice training in district	8.51	2.13*	−16.47	−1.21
Teachers involved/computer decisions	1.55	1.49	−2.46	−0.35
Incentives				
Release time	−1.80	−0.45	−4.75	−0.58
Extra pay	3.15	0.29	4.75	0.46
Promotions	3.59	0.87	5.10	0.99
Special recognition	−5.07	−2.44*	−5.01	−0.84
Computer set aside for teachers	−2.31	−1.14	1.77	0.44
Teachers may borrow computers	0.69	0.33	16.62	1.09
Adjusted R^2	0.31		0.24	
F	2.91***		2.35**	
N	143		143	

NOTES: Breadth of use is an eight-point scale, with higher values indicating greater use across subjects and grades. (*** = $p < .001$; ** = $p < .01$; * = $p < .05$.)

recognition" as an incentive for using microcomputers also interacts with black student composition. This incentive is relatively more effective where there are proportionately *fewer* black students. This is somewhat puzzling. We can only speculate that the effects of this incentive are more valued in majority circumstances. Increased curricular support and the provision of inservice training seem particularly valued where more minority students are served.

IV. DISCUSSION AND POLICY IMPLICATIONS

This research has examined the incentive value of various administrative policies in encouraging teachers to participate in inservice computer training programs and in encouraging more widespread use of microcomputers for subject matter instruction. Our results indicate that certain administrative policies are especially effective in achieving these ends. This section reviews these findings and explores their policy implications for staff development and for microcomputer use.

EFFECTIVE ADMINISTRATIVE POLICIES

Our conceptual framework defined three administrative policy mechanisms that affect staff development and computer use:

- *Demonstrating administrative commitment* through the provision of various forms of technical support.
- *Involving teachers in decisionmaking* regarding staff development and computer use.
- *Providing incentives and rewards* to teachers.

Increased availability of microcomputers is clearly the critical ingredient for increasing teachers' participation in inservice computer training programs. Provision of microcomputers, assistance in integrating computers into the curriculum, and provision of inservice training are the major ingredients for broadening the use of microcomputers for subject matter instruction. To a lesser extent, extra pay for computer-using teachers also broadens the use of microcomputers. Other policies, such as involving teachers in decisions or offering various incentives, are less effective.

Inservice Training

We examined the level of teacher participation in inservice computer training programs, as well as the representation of elementary, math, science, and English teachers in such programs. Our primary finding in this area is that more teachers participate in inservice computer training as more microcomputers are made available to them. Other important conditions include the availability of resource persons in teachers' schools, teacher participation in the planning of staff

development, release time for workshops, and guaranteed access to microcomputers or software upon completion of training.

In the end, however, *making more microcomputers available to teachers* is the single policy mechanism with the greatest value for increasing teachers' participation in district inservice computer training. *If districts acquire a sufficient number of computers and offer training, teachers will indeed participate.* We hypothesized that extrinsic incentives such as special recognition and intrinsic incentives such as release time—traditional mechanisms for encouraging staff development—would strongly increase inservice training. Our findings suggest, however, that the increased availability of a critical resource is overriding. Provision of vital resources is visible evidence of the commitment of the school district to the accomplishment of staff development objectives (Howey and Vaughan, 1983), and from the teachers' perspective, it enhances the utility of receiving training in the use of a new technology.

We also examined how organizational features of inservice training affect participation, and we saw some scattered evidence that organizational improvements recommended in the literature are indeed associated with enhanced participation. Holding inservice training at teachers' own schools encourages overall participation, and other organizational features may have special appeal to teachers of different grades and subjects (e.g., advanced classes for elementary teachers). Nonetheless, alterations in the conditions of staff development pale in importance compared with increased availability of microcomputers.

The limitations of these analyses must be considered in interpreting these findings, however. Our attempts to model inservice participation were only partially successful. While our model predicting the percentage of teachers receiving training is statistically significant, it still accounts for a modest amount of variance in the outcome measure; in addition, we were not able to model well the representation of different types of teachers. Factors other than those measured in these models may also affect teacher participation. Moreover, while participation is essential for inservice training to have any utility, our findings do not speak to broader issues of the effectiveness of such training. Other support factors examined in this research and practices identified in the literature (e.g., Wade, 1984/1985) may play important roles in improving the effectiveness of inservice training. A great deal more research is needed on the issue of how best to train teachers to use microcomputers.

Breadth of Microcomputer Use

We also examined the value of alternative administrative computer policies in promoting more widespread use of microcomputers as a tool for teaching math, science, English, and social studies in elementary and secondary grades. The results were striking. All of the policy mechanisms hypothesized to enhance microcomputer use did so, but three forms of technical support stand out: increased numbers of microcomputers per teacher, the provision of staff development in the district, and especially the availability of assistance to teachers in integrating microcomputers into instruction.

Integration assistance is the least commonly provided form of technical support in our survey districts. We are referring not to maintenance of machinery or advice with locating, selecting, and obtaining courseware, but to *curricular* assistance to help teachers decide the optimal ways to deliver computer-based instruction to students, to link the computer activities with ongoing instruction, and to coordinate those activities with other classroom activities. It is the necessary bridge between implementation of the technology and the achievement of worthwhile pedagogical objectives. In short, it demands the routine availability of a person to help teachers in the various grades and subjects optimize their own computer use.

Also important for improving the breadth of microcomputer use are increased availability of hardware and the provision of inservice computer training. Our results show clearly that technology is used more widely as it becomes more available. Increased availability of hardware exemplifies administrative commitment to making innovations work (Gross, Giacquinta, and Bernstein, 1971), and it also enhances the simple utility of using microcomputers for instruction. Staff development is also an incentive for using innovations (Schlechty and Vance, 1983; Futrell, 1983). The provision of inservice training is a critical determinant of computer use for subject matter instruction. Such training is widely available in the survey districts; the few districts that do not have it are apparently set back in incorporating microcomputers into the wider curriculum.

The associations of most other policy mechanisms with computer use are less important. We expected that teacher incentives and participatory decisionmaking would be associated with more widespread computer use, and indeed these factors appear generally helpful; at least, none was found to be harmful. The extrinsic incentive of extra pay was shown to encourage wider microcomputer use, although previous research had led us to believe that intrinsic incentives might be more powerful. In any case, when districts can find ways to compen-

sate computer-using teachers, computer use increases—although the reasons for this are not entirely clear. More pay may stimulate computer use where none existed, or it may deter computer-using teachers from leaving the teaching profession (Shavelson et al., 1984a).

We again note that encouraging more widespread use of microcomputers for instruction is only the first step in achieving their potential as an instructional tool. Once usage begins, specific methods of use become important. We do not now know the most beneficial applications of microcomputer-based instruction in the various subjects and grades. Further research is needed on this issue and on the corollary problem of how best to encourage these applications.

Administrative Policies and Minority Composition

Technical support is particularly critical for broadening the use of microcomputers in districts that serve a higher proportion of black students, as is the provision of computer integration assistance and inservice training.

Our data do not reveal why this appears to be the case, but these findings have important implications for educational equity. They suggest that if technical assistance and inservice computer training are *not* provided, classes with high proportions of black students may receive less exposure to computers across their various classes. If computers will truly bring benefits to our lives and livelihoods, the absence of such technical support will put these students at a disadvantage.

POLICY IMPLICATIONS

These results have practical implications for district and school policies guiding the acquisition of hardware and software and the provision of inservice training, teacher incentives, and other forms of technical assistance. We illustrate alternative policies for enhancing teacher training and computer use by describing actions taken by the districts and schools in our study. In addition to our telephone survey, we visited a small number of districts and schools to observe some innovative programs for encouraging teacher training and instructional computer use.

Our findings suggest that participation in teacher training and the use of microcomputers in subject matter courses increases along with the number of microcomputers per teacher in the district. In the districts in this study, there was less than one microcomputer for every two teachers and every 33 students; the ratio rarely exceeded one

microcomputer for every teacher and every 11 students. Today, only one-quarter of all U.S. schools have enough computers to serve between one-half and one full classroom of students at a time (Becker, 1986). There is considerable room to expand the acquisition of microcomputers in the public schools.

Educators and policymakers who wish to encourage the use of microcomputers for subject matter instruction should encourage investments in computer hardware and courseware. Local conditions, of course, will determine the precise forms of such investments. Many administrators have mobilized support imaginatively, obtaining donations from parents, community organizations, and commercial suppliers of hardware and courseware. Hardware manufacturers and courseware developers are competing fiercely for market share, and some districts have negotiated volume discounts on equipment and licensing arrangements for courseware. Some districts have established special arrangements with local manufacturers and distributors of hardware and courseware, for example, agreeing to field test new equipment or software in return for favorable terms.

Districts and schools ultimately require government support to incorporate computers into the instructional program, however, because of the large capital investments and training costs involved (Rogers, 1984). Over half of the computer-using school districts used Chapter II block grants to acquire hardware and software (*School Tech News*, 1984). Chapter I grants are sometimes used to acquire computers, and state and local funds often support training.

However, districts and schools may need more information and clarification about available aid. While most of the districts in this study use some federal, state, or local government funds to support their microcomputer programs, a sizable fraction do not. Some were unaware of the existence of programs such as state initiatives to support teacher training; others were unsure about the conditions of use of such funds (e.g., they did not know whether Chapter II funds could be used to acquire computers). An important area of concern is whether equipment purchased under Chapter I grants can be made available to students who are not economically and educationally disadvantaged, once the target student population has been served. Concern about this issue has caused some districts to forestall acquisition of hardware under Chapter I funds. In other cases, strict interpretation of the guidelines causes the microcomputers to be used only with remedial (i.e., drill-and-practice) courseware or to be left unused for long periods during the school day.

There is no question about the importance of making more microcomputers available to teachers, but it is important to recognize that

the availability of larger numbers of microcomputers does not in itself ensure that they will be used. In some schools, large numbers of microcomputers sit unused (Schorr, 1983). Indeed, we observed one large computer lab full of new equipment that sat unused most of the school day, because little courseware had been acquired and there was little assistance for teachers who would have liked to use the computer lab. The increased availability of microcomputers is thus a *necessary but not sufficient* condition for increased computer use.

Teachers must also be provided with *centralized, routine assistance in integrating computers into the curriculum of instruction*, particularly in districts with higher proportions of black students. The importance of such assistance is not yet widely recognized, although it may be the crucial ingredient for enhancing subject matter computer use. Further study is needed on how to achieve curricular integration in districts, schools, and classrooms, consistent with teachers' instructional programs and needs. One part of the solution is to appoint a computer coordinator to work closely with teachers (Yin and White, 1984). This person, however, should be not only a coordinator of hardware, software, and training, but a *computer curriculum adviser* as well. Many of the computer supervisors who participated in this study did not provide such assistance; a few were even constrained from "invading the turf" of traditional subject matter curriculum coordinators.

In the districts we visited, the presence of a committed person in the central office who could help with computer integration made a dramatic difference. Many of these individuals had been teachers in the district and now devoted all of their time to supporting other computer-using teachers. They were not "resource persons" who provided assistance in addition to regular teaching duties. Larger districts may need several full-time advisers who specialize in computer use by grade level or subject matter.

Resources are again at issue in recommending the appointment of computer integration specialists. Many districts are recognizing the need to provide budgetary authorization for such new administrative positions. In one district we surveyed, grants were provided by the state expressly for this position, allowing for the rotation of different computer-using teachers into the position over time. The position offered teachers in that district a change from the classroom into a novel, albeit temporary, administrative position.

Another necessary condition for stimulating computer use in more subjects and grades is the *provision of inservice computer training*, particularly in districts serving a higher proportion of black students. Most of the districts in this study have implemented some form of inservice training. While the nature and form of the training programs

vary greatly, the very existence of inservice training is enough to stimulate more widespread use of microcomputers for instruction.

Although we found the *conditions* of inservice training to be of secondary importance for encouraging more widespread computer use, it is important that training be *accessible to teachers.* Participation increases when training is held in teachers' schools and when teachers are given release time. One novel arrangement we observed involved the use of a mobile microcomputer lab in a remodeled trailer. On teachers' request, the trailer was transported to their schools for inservice workshops.

Also, there is evidence that the conditions of inservice training should differ for teachers of different subjects and grades, i.e., for elementary and secondary teachers. This would be consistent with general recommendations that inservice training be adapted to the specialized needs of teachers. Our research does not address the specific needs of different populations of teachers, but this is an important area needing further study.

Our research indicates that teachers should be included in decision-making regarding inservice computer training and the implementation of computers into the instructional program. While improved technical support is a more powerful facilitator, the incentive value of teacher participation can also be significantly positive. We found no evidence that programs implemented without teacher involvement had better training or computer use results.

Finally, ways must be found to *compensate computer-using teachers* to encourage the use of microcomputers for subject matter instruction. The significance of extra pay is all the more remarkable for its rarity in the school districts in our survey. The few compensation programs that do exist include a computer master teacher program, salary credit for using computers, and summer stipends for curriculum development. There is no doubt that the resources for such programs are scarce and that the concept of differential pay is controversial. But there is also no doubt about the exodus of trained teachers, especially in districts with high percentages of minority students (Darling-Hammond, 1984), or about the high value of computer skills in today's labor market.

Other, traditional incentives dispensed by administrators to teachers may have some minor value for encouraging training and broadening computer use. In general, however, rewards such as special recognition or even release time make little difference relative to other mechanisms of providing support. The fundamental, necessary ingredient for increasing teacher training and computer use is technical support of sufficient availability to meet the needs of teachers. Only when such support is provided will teachers widely accept the challenge of using microcomputers for instruction.

Appendix

SURVEY INSTRUMENT

FORM A

2/18/85

Case # _ _ _ _ _ _ _ _

COMPUTER INTERVIEWING PROJECT

District Interview Guide

ASSURANCE OF CONFIDENTIALITY

All information which would permit identification of respondents will be regarded as strictly confidential, will be used only for the purposes of the study, and will not be disclosed or released for any other purposes without prior consent, except as required by law.

The Rand Corporation
Santa Monica, CA

Introduction

ASK TO SPEAK TO RESPONDENT. IF NOT AVAILABLE ASK FOR BEST TIME AND NUMBER TO CALL.

INTRODUCTION:

Hello, this is _____ calling from the Rand Corporation in Santa Monica, California. Rand is a public, nonprofit research institution, and we are currently conducting a study of instructional uses of microcomputers in public schools.

We recently sent you a letter asking for your help in a brief telephone survey about computer-related staff development opportunities in your district and about what your district may be doing to encourage teachers' use of microcomputers for classroom instruction.

The interview will take about fifteen minutes. Is now a convenient time? IF RESPONDENT IS NOT AVAILABLE NOW, FIND OUT THE BEST TIME TO CALL HIM/HER BACK AND RECORD ON CALL RECORD.

IF RESPONDENT ASKS ABOUT CONFIDENTIALITY, READ STATEMENT ON COVER. SAY: Let me read you Rand's Statement of Confidentiality.

WRITE IN THE TIME YOU BEGAN THE SURVEY ---> _____ AM PM

I would like to start by asking you about computer use in your district.

1. Approximately how many *microcomputers* are available for instruction in the district?

   _____

2. Of these microcomputers, approximately how many would you say are usually found: (READ LIST)

   a. In *elementary* schools?..... _____

   b. In *secondary* schools?..... _____
      (including middle schools, if any)

   NOTE: Total should be equal to Q1. Probe any discrepancy.

3. Are the microcomputers *distributed* among the schools in your district or do they tend to be *concentrated* in one or two schools?
   (Circle One)

   DISTRIBUTED AMONG THE SCHOOLS..... 1

   CONCENTRATED IN A FEW SCHOOLS..... 2

4. Do those schools with microcomputers keep them *all* year or are the microcomputers *rotated* among the schools? (PROBE: Do *all* schools keep/rotate their microcomputers?)

(Circle One)

ALL SCHOOLS KEEP THEIR MICROCOMPUTERS *ALL* YEAR..... 1

SOME MICROCOMPUTERS ARE ROTATED; SOME STAY IN THE SAME SCHOOLS ALL YEAR..... 2

ALL MICROCOMPUTERS ARE ROTATED AMONG THE SCHOOLS... 3

5. Are the microcomputers in the elementary schools (K-5,6) *primarily* located in separate labs, or are they primarily located *in or adjacent to* teachers' classrooms?

(Circle One)

LABS..... 1

CLASSROOMS..... 2

AREN'T ANY IN ELEMENTARY GRADES..... 3

6. What about the microcomputers in the secondary schools (6, 7-12)--are they primarily located in *separate* labs, or are they primarily located *in or adjacent to* teachers' classrooms?

(Circle One)

LABS..... 1

CLASSROOMS..... 2

AREN'T ANY IN SECONDARY GRADES..... 3

Now let me ask you about how microcomputers are used for *instruction* in your district.

		YES	NO
7.	In your district, are microcomputers used: (READ ITEM)		
	a. For instruction in *computer literacy*?.....	1	2
	b. For instruction in *programming*?.....	1	2
	c. As a *problem-solving* device, for example, for computation or for data analysis?.....	1	2
	d. To teach *special* populations such as gifted, disadvantaged?.....	1	2
	e. As an instructional *tool* in regular subjects and courses, such as for drill-and-practice or tutorials in science, math, English?.....	1	2

8. Of the various applications I just mentioned, which instructional uses of computers are *emphasized* in your district?
PROBE: What others are *emphasized*?

(Circle all that apply)

COMPUTER LITERACY..... 1

PROGRAMMING..... 2

PROBLEM-SOLVING..... 3

TEACH SPECIAL POPULATIONS..... 4

INSTRUCTIONAL *TOOL* IN
REGULAR INSTRUCTION (CAI)..... 5

9. Does your district have *written goals* for student computer use?
PROBE: By that I mean written policies.

(Circle One)

NO, NO WRITTEN GOALS..... 1

IN PROGRESS..... 2

YES, ALREADY WRITTEN..... 3

10. *How involved* are *teachers* in deciding how microcomputers will be used for instruction in this district? Would you say *teachers* are *highly* involved, *moderately* involved, *somewhat* involved, or *not very* involved in these decisions? PROBE: In general...

(Circle One)

HIGHLY INVOLVED..... 1

MODERATELY INVOLVED..... 2

SOMEWHAT INVOLVED..... 3

NOT VERY INVOLVED..... 4

11. Are microcomputers being used currently in your district *for instruction* in any of the following subjects or courses? Let's start with math. Are any microcomputers currently being used for: (READ LIST)

	(i) NO	YES	(ii) IF YES, ASK: Are they currently being used in:	YES	NO
a. Math?.....	1	2 --->	Elementary Grades (K-5,6).....	1	2
			Secondary Grades (6,7-12).....	1	2
b. Science?.....	1	2 --->	Elementary Grades (K-5,6).....	1	2
			Secondary Grades (6,7-12).....	1	2
c. Social Studies?.	1	2 --->	Elementary Grades (K-5,6).....	1	2
			Secondary Grades (6,7-12).....	1	2
d. English?.....	1	2 --->	Elementary Grades (K-5,6).....	1	2
			Secondary Grades (6,7-12).....	1	2

12. What *percentage* of teachers in your district would you estimate are teaching courses in which microcomputers are *used as an instructional tool* (e.g., for drill-and-practice in math; word processing in English, etc.)?

Percent _____

OR

Don't know..... DD

13. What is your best estimate of how many minutes a typical student, who *uses microcomputers*, spends using microcomputers for instruction during a school day?

Minutes _____

OR

Don't know..... DD

BEST COPY AVAILABLE

I'd like to ask a few questions about *support* available to teachers who use microcomputers for instruction in this district.

14. Can teachers who use microcomputers in this district receive any of the following support services? (READ LIST)

	YES	NO
a. Assistance with installing or maintaining *equipment*?..	1	2
b. Help with locating and evaluating appropriate *courseware* (instructional programs)?.....	1	2
c. Help with deciding how to *integrate* computer activities into their regular instructional curriculum?.....	1	2

15. Are there designated *resource persons* in most schools in your district who can help microcomputer-using teachers with day-to-day problems?

(Circle One)

NO RESOURCE PERSONS..... 1

A FEW PEOPLE ARE RESOURCE PERSON(S) FOR THE DISTRICT (e.g., RESPONDENT)..... 2

YES--THERE ARE COMPUTER RESOURCE PERSONS IN MOST OR ALL SCHOOLS..... 3

16. Does the district purchase *courseware* (educational programs) for teachers who use microcomputers for instruction?

NO..... 1

YES..... 2 ---> Of courseware purchased by the district, what *percent* of courseware would you estimate has been purchased for use in: (READ LIST)

a. Math classes?..... Percent _____

NOTE: Percents need not total to 100.

b. Science classes?..... Percent _____

c. English classes?..... Percent _____

17. Regarding *funding* for microcomputers, what percent of funds spent this school year on all microcomputer-related activities would you estimate comes from *Government programs or grants*?

DEFINE: What ever your district considers a Government program or grant to be. Percent _____

18. Some districts offer various "*rewards*" and "*incentives*" to encourage teachers' to use microcomputers for instruction. Does your district provide teachers *who use microcomputers* with any of the following incentives: Does the district provide: (READ LIST)

a. Release time to develop computer-related curricular materials?..... NO..... 1

YES..... 2 ---> How many hours? ____ (total)

b. Higher pay as a teacher?.... NO..... 1

YES..... 2

c. The possibility of advancement to an administrative position?.... NO..... 1

YES..... 2

d. Recognition from peers or the administration?..... NO..... 1

YES..... 2 ---> What kind? _____

_____

e. Any others?..... NO..... 1

YES..... 2 ---> What?_____

_____

19. Have any microcomputers been set aside *exclusively* for teacher use *outside of class hours* (e.g., to practice using them)?

(Circle One)

YES..... 1

NO..... 2

20. When school is closed either for the summer or extended holidays, can teachers borrow microcomputers and take them home?

(Circle One)

YES..... 1

NO..... 2

I'd like to ask you now about *staff development* for instructional use of microcomputers in your district.

21. Is your district currently providing teachers with inservice training in how to use microcomputers? (By staff development I mean activities to advance teachers' knowledge and skills regarding the use of microcomputers.)

(Circle One)

NOT CURRENTLY..... 1 ---> **SKIP TO Q.33, PAGE 10**

YES, *DISTRICT* OR *SCHOOLS* CURRENTLY PROVIDE INSERVICE TRAINING..... 2 ---> **CONTINUE WITH Q.22**

22. Does this staff development occur on a *regular* schedule or does it occur on an *AD HOC* basis?

(Circle One)

REGULARLY SCHEDULED..... 1

OCCURS IN WORKSHOPS "AS NEEDED"..... 2

BOTH..... 3

23. Is participation *voluntary* or *mandatory*?

(Circle One)

PURELY VOLUNTARY..... 1

PARTLY MANDATORY (e.g., AT FIRST OR IN SOME SCHOOLS)..... 2

COMPLETELY MANDATORY..... 3

24. Is staff development available in teachers' *own schools*?

(Circle One)

YES..... 1

NO..... 2

25. Aside from any introductory classes, are there "*advanced*" classes in which teachers can receive further computer training?

(Circle One)

NO, INTRODUCTORY CLASSES ONLY..... 1

ADVANCED CLASSES..... 2

26. All together, approximately how many *hours* of staff development are offered to teachers during the school year? PROBE: What is the total number of hours a teacher can have during a school year?

Hours _____

27. For the average teacher taking staff development, what *percent* of staff development *time* would you estimate is spent on "hands-on" experience? PROBE: By "hands on" we mean at the terminal.

Percent _____

28. Who provides the inservice training? (Circle all that apply)

MEMBERS OF THE DISTRICT OR SCHOOL ADMINISTRATION..... 1

TEACHERS IN THE DISTRICT..... 2

CONSULTANTS OR "EXPERTS" FROM OUTSIDE THE DISTRICT.... 3

OTHER, SPECIFY_____..... 4

29. In your estimate, what percentage of the teaching staff has received inservice computer training?

Percent _____

30. How involved are *teachers* in deciding the *content* and *organization* of *staff development* in microcomputer-based instruction? Would you say teachers are *highly* involved, *moderately* involved, *somewhat* involved, or *not very* involved in these decisions?
PROBE: In general...

(Circle One)

HIGHLY INVOLVED..... 1

MODERATELY INVOLVED..... 2

SOMEWHAT INVOLVED..... 3

NOT VERY INVOLVED..... 4

31. In your opinion, how *well represented* in district computer staff development are the following groups of teachers? Are (READ TYPE OF TEACHER) *poorly* represented, *moderately* represented, or very *well* represented? PROBE: In general...

TYPES OF TEACHER	Poorly Represented	Moderately Represented	Well Represented
a) Elementary Teachers.....	1	2	3
b) Secondary Teachers.....	1	2	3
c) Math Teachers.....	1	2	3
d) Science Teachers.....	1	2	3
e) English Teachers.....	1	2	3

32. Some districts offer various "rewards" and "incentives" to encourage teachers to participate in computer-related staff development. Does your district provide teachers with any of the following incentives for taking inservice training? Does the district provide: (READ LIST)

a) Release time to take classes?. NO..... 1

YES..... 2 ---> How many hours? _____ (total per year)

b) Higher pay as a teacher?..... NO..... 1

YES..... 2

c) The possibility of advancement to an administrative position?.....NO..... 1

YES..... 2

d) Guarantee of computer equipment or software?..... NO..... 1

YES..... 2

e) "Special recognition"?..... NO..... 1

YES..... 2 ---> What kind? _____

_____

f) Any others?..... NO..... 1

YES..... 2 ---> What?_____

_____

33. What percentage of teachers in your district would you estimate have taken computer classes *on their own* outside the district (e.g., in local colleges or night classes)?

Percent _____

34. Can teachers who take computer classes *on their own* get release time, have their expenses reimbursed, receive salary credit, or anything like that? PROBE: What else?

(Circle all that apply)

NO INCENTIVES OR REWARDS..... 1

CAN RECEIVE RELEASE TIME TO TAKE CLASSES..... 2

CAN HAVE EXPENSES REIMBURSED..... 3

CAN RECEIVE HIGHER SALARY..... 4

CAN RECEIVE PROMOTION TO ADMINISTRATIVE POSITION..... 5

CAN RECEIVE "SPECIAL RECOGNITION"..... 6

CAN RECEIVE *OTHER REWARDS*..... 7

WHAT?_____

My final questions are about how teachers use microcomputers as an instructional tool in *subject matter courses* such as math, science, and English.

35. To the best of your knowledge, are teachers in your district making *extensive*, *moderate*, or *minimal* use of the following kinds of microcomputer-based instructional materials: (READ LIST)
PROBE: In general...

	Extensive	Moderate	Minimal
a. Drill-and-practice programs?.....	1	2	3
b. Tutorial programs?.....	1	2	3
c. Simulation programs?.....	1	2	3

36. Generally speaking, how well *integrated* into the ongoing curriculum of instruction are microcomputer-based learning activities *at this time*? Would you say *extensively*, *moderately*, or *minimally* integrated into ongoing instruction? PROBE: In general...

(Circle One)

EXTENSIVELY..... 1

MODERATELY..... 2

MINIMALLY..... 3

Thank you very much for your help in this survey.

As we mentioned in our letter, we would also like to talk to two or three teachers in your district to learn more about how they are using microcomputers for instruction. We would especially like to talk to teachers who are currently using microcomputers regularly as an instructional tool for teaching classes in *math*, *science*, or *English* at the elementary level and at the secondary level. Can you suggest teachers for us to call? RECORD NAME AND PHONE NUMBER OF PERSON ON YOUR CALL RECORD. ALSO NOTE GRADE LEVEL AND SUBJECT MATTER TAUGHT BY TEACHERS NOMINATED BY RESPONDENT.

Thank you again. Since we will be trying to reach these people soon, we would greatly appreciate if you could let them know that we will be calling. By the way, their interview will be shorter than this one.

WRITE IN THE TIME YOU ENDED THE SURVEY ---> _____ AM/PM

INTERVIEWER REMARKS

(Fill out after you complete the survey)

37. **LENGTH OF THE INTERVIEW ---------->**

_____
Minutes

38. **DATE INTERVIEW COMPLETED**

MO | DAY | YR

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